Learning Outcomes Based Curriculum Framework (LOCF)

for

Computer Science & Information Technology

Postgraduate Programme

2020

Department of Computer Science & Information Technology

Cotton University

Panbazar, Guwahati

Assam

PART I

1.1 Introduction

"Computers are incredibly fast, accurate, and stupid. Human beings are incredibly slow, inaccurate, and brilliant. Together they are powerful beyond imagination."- Albert Einstein

The study of computing, automation, and information is known as computer science. Theoretical disciplines (such as algorithms, theory of computing, and information theory) and practical disciplines (such as programming) are all part of computer science (including the design and implementation of hardware and software). Computer science is distinct from computer programming in that it is a field of academic research.

Computer science is based on algorithms and data structures. The theory of computing is concerned with abstract models of computation and the general types of problems that they may solve. The areas of cryptography and computer security are concerned with the development of methods for secure communication and the prevention of security flaws. Image generation is addressed by computer graphics and computational geometry. Database theory is concerned with the administration of data repositories, whereas programming language theory is concerned with methods to the representation of computer operations. Human–computer interaction studies the interactions between humans and computers, whereas software engineering studies the design and concepts of software development. Operating systems, networks, and embedded systems are all research areas that look at the concepts and design of complex systems. The building of computer components and computer-operated equipment is referred to as computer architecture. Artificial intelligence and machine learning aspire to synthesize goal-oriented processes present in people and animals, such as problem-solving, decision-making, environmental adaptability, planning, and learning. Computer vision tries to comprehend and process image and video data, whereas natural-language processing strives to understand and process textual and linguistic data in artificial intelligence.

This postgraduate programme in computer science and information technology is designed to introduce the basic concepts of the subject and to enable the students to understand and analyze the current-edge technologies, issues and challenges through the various applications of computer science. The programme covers fundamental concepts of the subject - the foundation subjects, core subjects, and department specific elective subjects. The programme is designed in such a manner that it enables the students to apply core and programming knowledge to solve a wide range of real-life problems and issues and acquire research skills to produce research

findings using in-depth subject knowledge, statistical tools, programming skills and current-edge technologies.

1.2 Learning Outcomes-based Approach to Curriculum Planning and Development

The basic objective of the learning outcome based approach to curriculum planning and development is to focus on demonstrated achievement of outcomes (expressed in terms of knowledge, understanding, skills, attitudes and values) and academic standards expected of graduates of a programme of study. Learning outcomes specify what graduates completing a particular programme of study are expected to know, understand and be able to do at the end of their programme of study.

The expected learning outcomes are used to set the benchmark to formulate the course outcomes, programme specific outcomes, programme outcomes and graduate attributes. These outcomes are essential for curriculum planning and development, and in the design, delivery and review of academic programmes. They provide general direction and guidance to the teaching-learning process and assessment of student learning levels under a specific programme.

The overall objectives of the learning outcomes-based curriculum framework are to:

- Help formulate graduate attributes, qualification descriptors, programme learning outcomes and course learning outcomes that are expected to be demonstrated by the holder of a qualification;
- Enable prospective students, parents, employers and others to understand the nature and level of learning outcomes (knowledge, skills, attitudes and values) or attributes a graduate of a programme should be capable of demonstrating on successful completion of the programme of study;
- Maintain national standards and international comparability of learning outcomes and academic standards to ensure global competitiveness, and to facilitate student/graduate mobility;
- Provide higher education institutions an important point of reference for designing teaching-learning strategies, assessing student learning levels, and periodic review of programmes and academic standards.

1.3 Key outcomes underpinning curriculum planning and development

The learning outcomes-based curriculum framework is a framework based on the expected learning outcomes and academic standards that are expected to be attained by graduates of a programme of study. The key outcomes that underpin curriculum planning and development include Graduate Attributes, Programme Outcomes, Programme Specific Outcomes, and Course Outcomes.

1.3.1 Graduate Attributes

The disciplinary expertise or technical knowledge that has formed the core of the university courses. They are qualities that also prepare graduates as agents for social good in future. Some of the characteristic attributes that a graduate should demonstrate are as follows:

1. **Disciplinary knowledge**: Capable of demonstrating comprehensive knowledge and understanding of one or more disciplines.
2. **Research-related skills**: A sense of inquiry and capability for asking relevant/appropriate questions, problematising, synthesizing and articulating.
3. **Analytical reasoning**: Ability to evaluate the reliability and relevance of evidence; identify logical flaws and holes in the arguments of others.
4. **Critical thinking**: Capability to apply analytic thought to a body of knowledge.
5. **Problem solving**: Capacity to extrapolate from what one has learned and apply their competencies to solve different kinds of non-familiar problems.
6. **Communication Skills**: Ability to express thoughts and ideas effectively in writing and orally.
7. **Information/digital literacy**: Capability to use ICT in a variety of learning situations, demonstrate ability to access, evaluate, and use a variety of relevant information sources; and use appropriate software for analysis of data.
8. **Self-directed learning**: Ability to work independently, identify appropriate resources required for a project, and manage a project through to completion.
9. **Cooperation/Team-work**: Ability to work effectively and respectfully with diverse teams.
10. **Scientific reasoning**: Ability to analyze, interpret and draw conclusions from quantitative/qualitative data; and critically evaluate ideas, evidence and experiences from an open-minded and reasoned perspective.
11. **Reflective thinking**: Critical sensibility to lived experiences, with self-awareness and reflexivity of both self and society.
12. **Multicultural competence**: Possess knowledge of the values and beliefs of multiple cultures and a global perspective.
13. **Moral and ethical awareness/reasoning**: Ability to embrace moral/ethical values in conducting one's life, formulate a position/argument about an ethical issue from multiple perspectives, and use ethical practices in all work.
14. **Leadership readiness/qualities**: Capability for mapping out the tasks of a team or an organization, and setting direction, formulating an inspiring vision, building a team who can help achieve the vision, motivating and inspiring team members to engage with that

vision, and using management skills to guide people to the right destination, in a smooth and efficient way.

15. **Lifelong learning**: Ability to acquire knowledge and skills, including 'learning how to learn', that are necessary for participating in learning activities throughout life, through self-paced and self-directed learning aimed at personal development, meeting economic, social and cultural objectives, and adapting to changing trades and demands of work place through knowledge/skill development/reskilling.

1.3.2 Programme Outcomes (POs) for Postgraduate programme

POs are statements that describe what the students graduating from any of the educational programmes should be able to do. They are the indicators of what knowledge, skills and attitudes a graduate should have at the time of graduation.

1. **In-depth knowledge**: Acquire a systematic, extensive and coherent knowledge and understanding of their academic discipline as a whole and its applications, and links to related disciplinary areas/subjects of study; demonstrate a critical understanding of the latest developments in the subject, and an ability to use established techniques of analysis and enquiry within the subject domain.
2. **Understanding Theories**: Apply, assess and debate the major schools of thought and theories, principles and concepts, and emerging issues in the academic discipline.
3. **Analytical and critical thinking**: Demonstrate independent learning, analytical and critical thinking of a wide range of ideas and complex problems and issues.
4. **Critical assessment**: Use knowledge, understanding and skills for the critical assessment of a wide range of ideas and complex problems and issues relating to the chosen field of study.
5. **Research and Innovation**: Demonstrate comprehensive knowledge about current research and innovation, and acquire techniques and skills required for identifying problems and issues to produce a well-researched written work that engages with various sources employing a range of disciplinary techniques and scientific methods applicable.
6. **Interdisciplinary Perspective:** Commitment to intellectual openness and developing understanding beyond subject domains; answering questions, solving problems and addressing contemporary social issues by synthesizing knowledge from multiple disciplines.
7. **Communication Competence:** Demonstrate effective oral and written communicative skills to covey disciplinary knowledge and to communicate the results of studies undertaken in an academic field accurately in a range of different contexts using the main concepts, constructs and techniques of the subject(s) of study

8. **Career development**: Demonstrate subject-related knowledge and skills that are relevant to academic, professional, soft skills and employability required for higher education and placements.
9. **Teamwork**: Work in teams with enhanced interpersonal skills and leadership qualities.
10. **Commitment to the society and to the Nation:** Recognise the importance of social, environmental, human and other critical issues faced by humanity at the local, national and international level; appreciate the pluralistic national culture and the importance of national integration.

1.3.3 Programme Specific Outcomes (PSOs) in in Computer Science & Information Technology

Programme specific outcomes include subject-specific skills and generic skills, including transferable global skills and competencies, the achievement of which the students of a specific programme of study should be able to demonstrate for the award of the degree. The programme specific outcomes would also focus on knowledge and skills that prepare students for further study, employment, and citizenship. They help ensure comparability of learning levels and academic standards across universities and provide a broad picture of the level of competence of graduates of a given programme of study. The attainment of PSOs for a programme is computed by accumulating PSO attainment in all the courses comprising the programme.

PSO1: Ability to gather basic concepts of applied mathematics and programming as well as grasp the theoretical knowledge of computers to solve real life computational problems using efficient techniques.

PSO2: Ability to acquire knowledge about the proficient use of programming languages and ICT tools to solve domain specific problems.

PSO3: Ability to improvise existing tools and techniques to solve computational intensive real world problems.

PSO4: Ability to analyze a problem critically and designing system, component, or process for its solution using relevant techniques, resources, and tools of Information Technology.

PSO5: Ability to acquire domain specific expertise through discipline specific elective and project works.

PSO6: Ability to understand different computing techniques, apply these to one's own work and develop methodology/solutions for the problems which are multidisciplinary in nature.

PSO7: Ability to have competency to take up higher studies, research and development activities and ability to recognize the need for and to engage in life-long learning.

1.3.4 Course Level Learning Outcome Matrix

Course Level Learning Outcomes Matrix – **Core Course**

Programme Specific Outcomes	701	702	703	704	705	801	802	803	804	805	1001	1002
PSO1	X	X	X	X	X	X	X	X	X	X		
PSO2	X				X					X		
PSO3			X	X		X	X	X				
PSO4				X	X		X	X		X	X	X
PSO5											X	X
PSO6	X			X	X			X		X	X	X
PSO7			X	X		X	X	X	X			

Course Level Learning Outcomes Matrix **– Elective papers**

Programme Specific Outcomes	E01	E02	E03	E04	E05	E06	E07	E08	E09	E10	E11	E12	E13	E14	E15	E16	E17	E18	E19	E20	E21	E22	E23
PSO1	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
PSO2		X	X			X		X	X				X	X		X	X	X	X	X	X	X	X
PSO3				X	X				X	X	X				X					X	X	X	
PSO4	X		X	X								X				X		X	X				
PSO5	X	X	X	X		X	X	X	X		X	X	X	X		X	X	X	X	X	X	X	X
PSO6		X	X				X	X	X	X			X	X					X	X	X	X	X
PSO7	X	X		X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X

1.4 Teaching-learning process

The department of Computer Science & Information Technology, Cotton University has student-centric teaching-learning pedagogies to enhance the learning experiences of the students. All classroom lectures are interactive using ICT-enable techniques, allowing the students to have meaningful discussions, question and answer sessions. Apart from the physical classes, lectures are also held in online mode where students can have doubt clearing and discussions with the teachers. Most of the teachers use ICT facilities with power-point presentations, e-learning platforms and other innovative e-content platforms for student-centric learning methods. Apart from these, special lectures by invited experts, workshops, and seminars are held to augment knowledge, encourage innovative ideas and expose the students to global academic and research advancement.

The short-term projects, research projects, and assignments, which are the integral components of all the courses, enable the students to solve practical problems. Students are also being engaged in the in-house and external research projects for acquiring experiential learning. The laboratories of the department offer hands-on learning experiences to the students.

1.5 Assessment methods

A variety of assessment methods that are appropriate to the discipline are used to assess progress towards the course/programme learning outcomes. Priority is accorded to formative assessment. Progress towards achievement of learning outcomes is assessed using the following: closed-book examinations; problem based assignments; practical assignment; laboratory reports; individual project reports (case-study reports); team project reports; oral presentations, including seminar presentation; viva voce interviews; computerized testing and any other pedagogic approaches as per the context.

PART II

Structure of Post-Graduate programme in Computer Science & Information Technology

I. Outline of the courses under Choice Based Credit System:

The Postgraduate programmes consist of four semesters with minimum credits required for the complete programme being 80.

Each course in a programme will be from one of the following categories:

1. Core Course (Core): A course that should compulsorily be studied by a candidate as a core requirement is termed a Core Course. Each core course is of 4 credits.

2. Elective Course: A course that can be chosen from a pool of courses and which may extend the discipline/subject of study or provides exposure to some other discipline/subject or which enhances the student's proficiency or skill is termed an Elective course. Each elective course is of 4 credits.

3. UGC Recommended Audit Course and Bridge Course: A course that enhances the skill development of students apart from department specific core and elective subjects is termed as audit course. An audit course is an educational term for the completion of a course of study for which no assessment of the performance of the student is made nor grade awarded. A course that recalls the fundamentals of the programme for the students belonging to other disciplines is termed as bridge course. A bridging course is a university-preparation course with an academic curriculum that is offered to mature students as a means of preparing for the intellectual challenges of a university education, successful completion of which is recognized as a basis of admission to the University. Both audit and bridge courses are non-credit courses.

4. Practical/Tutorials: A practical or tutorial component (or both) is to be provided with every core and elective paper.

5. Dissertation/Project Work (DPW): A course designed for students to acquire special/ advanced knowledge that they study on their own with advisory support by a teacher/faculty member is a dissertation/project work. A DPW course is of 20 credits.

- The credits for a course will be of the structure L+T+P, where L, T and P stand for lecture, tutorial and practical respectively.
- Each 4 credit course with practical is of the pattern 3+0+1=4 and for a 4 credit course without practical, the pattern is 3+1+0=4.
- Each Elective course will be open to students from his/her own discipline.

· For the purpose of computation of workload, the mechanism adopted will be:

- 1 credit = 1 theory period of 1 hour duration per week.
- 1 credit = 1 tutorial period of 1 hour duration per week.
- 1 credit = 1 practical period of 2 hours duration per week.

II. Distribution of Courses and Credits

Postgraduate Programme (Computer Science & Information Technology)

A student in the MCA programme will take the following minimum number of courses in different categories of courses:

Table 1: Credit distribution for courses: M.Sc.

Category	Number of courses	Credits for each course	Total Credits
Core	10	4	40
Elective	5	4	20
DPW	1	20	20
			80

The distribution of credits and courses in each of the four semesters for the M.Sc. in AI & ML programme will be according to the following scheme:

Sem	Core	Audit	Bridge	Elective	DPW	Credit
I	C1(5) C2(5) C3(5) C4(5)	A1(0)	B(0)			20
II	C5(5) C6(5) C7(5) C8(5)	A2(0)				20

III		A3(0)		E1(5) E2(5) E3(5) E4(5)		20
IV					DPW(20)	20
Credit	20	0	0	20	20	80

COTTON UNIVERSITY

DEPARTMENT OF COMPUTER SCIENCE & INFORMATION TECHNOLOGY

Postgraduate Syllabus

COURSE STRUCTURE OF COMPUTER SCIENCE & INFORMATION TECHNOLOGY

(POSTGRADUATE PROGRAMME)

Paper Code	**Subject Title**	**L+T+P**
Semester I		
MCA701C	Programming Fundamentals	3+0+1
MCA702C	Computer Organization	3+1+0
MCA703C	Mathematical Foundations	3+1+0
MCA704C	Data Structures	3+0+1
MCA705C	Database Management Systems	3+0+1
UGC Audit Course (Non-credit)	Human Rights Education-I	1+1+0 (Non credit)
MCA-BRIDGE Bridge course (Non-credit)	Fundamentals of Computer	1+1+0 (Non credit)
Semester II		

MCA801C	Computational Mathematics	3+1+0
MCA802C	Operating Systems	3+0+1
MCA803C	Design and Analysis of Algorithms	3+0+1
MCA804C	Computer Networks	3+0+1
MCA805C	Software Engineering	3+1+0
UGC Recommended Audit Courses (Non-credit)	Human Rights Education-II	1+1+0 (Non credit)
Semester III		
MCA EXX	Elective	3+1+0
MCA EXX	Elective	3+1+0
MCA EXX	Elective	3+1+0
MCA EXX	Elective	3+1+0
MCA EXX	Elective	3+1+0
UGC Recommended Audit Courses (Non-credit)	Human Rights Education-III	1+1+0 (Non credit)
Semester IV		
MCA1001	Major Project	0+0+18
MCA1002	Seminar	0+0+2

Elective Papers

MCA E01	Computer Graphics	3+1+0
MCA E02	Digital Image Processing	3+1+0
MCA E03	Advanced Database Management System	3+1+0
MCA E04	Graph Theory and its applications	3+1+0
MCA E05	Computer Oriented Numerical Methods and Statistical techniques	3+1+0
MCA E06	Distributed Computing	3+1+0
MCA E07	Mobile Computing	3+1+0
MCA E08	Network Security and Cryptography	3+1+0
MCA E09	Data Mining	3+1+0
MCA E10	Optimization Techniques	3+1+0
MCA E11	Parallel Algorithm	3+1+0
MCA E12	Information Storage and Retrieval	3+1+0
MCA E13	Web Technology	3+0+1
MCA E14	Cloud Computing	3+1+0
MCA E15	Computational Geometry	3+1+0
MCA E16	Advanced Computer Architecture	3+1+0
MCA E17	Wireless Network	3+1+0
MCA E18	Speech Processing	3+1+0
MCA E19	Multimedia System	3+1+0
MCA E20	Pattern Recognition	3+1+0
MCA E21	Artificial Intelligence	3+1+0
MCA E22	Machine Learning	3+1+0
MCA E23	Big Data	3+1+0

Paper Code: MCA701C

Paper Title: Programming Fundamentals (4 Credits, L+T+P = 3+0+1)

The main objective of this course is to introduce the students to various concepts of programming languages. This course will familiarize the students with the concepts of C language syntax, data types, control statements, functions, pointers, arrays, structures, files, and graphics. Students will be able to solve problems using standard algorithms and translate pseudo-codes.

The specific learning outcomes are:

1. Define and describe various terms and concepts of C programming language.
2. Compare and interpret information based on their understanding of the concepts of C language syntax, data types, control statements, functions, pointers, arrays, structures, files, graphics and hardware programming using C.
3. Solve problems using standard algorithms and translate pseudo-codes into C programs and implement them.
4. Analyze their skills for choosing the right data structure, function, data types and develop logic to solve various instances of problems.
5. Combine the various concepts and ideas learnt in C to plan, propose and develop a product.
6. Evaluate various algorithms used for searching, sorting etc., in terms of correctness and computation cost.

Unit	Contents	No. of Lectures
1	**Basic Fundamentals** History of C, Evolution of Computer system, Classification of Computer, Modern Computer, Hardware and Software. Major components of a Digital	

	Computer, A brief introduction of CPU, Memory Hierarchy and I/O devices, Bootstrapping a Computer.	5
2	**Algorithm** Problem solving approaches: pseudocode, flowchart, algorithm, decision table; bottom-up and top down design strategies, notations of flowchart and algorithm, design and analysis of algorithms. Asymptotic notations: Definitions, physical representation, performance study and comparative analysis..	5
3	**Basics of C Language** Constant and variable, data types – primitive and user define; statement and expression; operators, hierarchy of operators and associativity, creation and evaluation of expressions; preprocessor directives, header files, macro, standard C library functions; control structures - decision making and loop; use of break, goto and continue statement.	12
4	**Array and Pointer** Array: representation of array – one dimensional, two dimensional and multi-dimensional; passing array elements to a function. Pointer: pointer and address, pointer arithmetic, pointer array, pointer and function argument Storage class: automatic, external, static, register, scope and lifetime of variables.	12
5	**Functions** Function definition, Declaration and prototypes, Call by Value and Call by Reference, Recursion.	6
6	**Structures and Files** Structure:declaration and use, member resolution operator – structure and structure pointer, arrays of structures. File operations: opening, closing, reading and writing of files, seeking forward and backward.	8
	Tutorial Tutorials will be based on theory.	16
	Practical- 1. Programs on input/output, control statement. 2. Programs on one dimensional, two dimensional array 3. Programs on use of pointers.	

	4. Programs on Functions: Call by Value and Call by Reference. 5. Programs on Structures. 6. Programs on file handling in C.	1 Credit

Reading List:

- G. Dromey, How to solve it by computer, PHI.
- Byron Gottfried, Programming with C, TMGH.
- Dennis Ritchie, ANSI-C Programming.
- YashavantKanetkar, Let us C
- E. Balaguruswamy, Programming in C
- ReemaThareja : Introduction to C Programming

Paper Code: MCA702C

Paper Title: Computer Organization (4 Credits, L+T+P = 3+1+0)

The main objective of this course is to introduce the students to architecture and organization of major components of modern computer systems. This course will familiarize the students with the concepts of Control Unit, instruction sets, instruction format, buses and register set. Students will be able to Compare and Analyze various architectures and their design considerations.

The specific learning outcomes are:

1. Understand the architecture and organization of major components of modern computer systems.
2. Explain the functioning and interconnection of major components of computer systems and different design issues associated with the design of any architecture.
3. Apply logic in designing simple control units, instruction sets, instruction format, buses and register sets etc.
4. Compare and Analyze different styles, strategies and formats adopted for designing the instruction set, register set, memory organization and I/O transfer.
5. Assess various architectures and their design considerations.
6. CO6: Construct and organize a new architecture by considering various design issues in order to make it more efficient with less overhead

Unit	Content	No. of Lectures
	Introduction to Digital Systems	

1	Introduction to Digital electronics, Digital and Analog Signals and Systems, Binary Digits, Logic Levels, and Digital Waveforms, Logic Systems-Positive and negative, Logic Operations, Combinational and Sequential Logic Functions, Programmable Logic.	4
2	**Number Systems and Codes** Introduction to Number Systems-Types-Decimal, Binary, Octal, Hexadecimal; Conversion from one number system to other; Binary arithmetic operations; Representation of Negative Numbers;1's complement and 2's complement, Complement arithmetic, BCD code.	4
3	**Logic Gates** Logical Operators, Logic Gates-Basic Gates, Other gates, Active high and Active low concepts, Universal Gates and realization of other gates using universal gates, Gate Performance Characteristics and Parameters.	4
4	**Boolean Algebra** Rules and laws of Boolean algebra, Demorgan's Theorems, Boolean Expressions and Truth Tables, Standard SOP and POS forms; Minterm and Maxterms, Canonical representation of Boolean expressions, Simplification of Boolean Expressions, Minimization Techniques for Boolean Expressions using Karnaugh Map and QuineMcCluskey Tabular method.	6
5	**Combinational Circuits** Introduction to combinational Circuits, Adders-Half- Adder and Full-Adder, Subtractors- Half and Full Subtractor; Parallel adder and Subtractor, Multiplexer, Demultiplexer, Encoder, Priority Encoder; Decoder, BCD to Seven segment Display Decoder/Driver, LCD Display, and Comparators.	6
6	**Sequential Circuits** Introduction to Sequential Circuits, Flip-Flops: Types of Flip Flops -RS, T, D, JK; Triggering of Flip Flops; Flip Flop conversions; Master-Slave JK.	7
7	**Registers and Counters** Synchronous/Asynchronous counter operation, Up/down synchronous counter, application of counter, Serial in/Serial out shift register, Serialin/Serial out shift register, Serial in/parallel out shift register, parallel in/ parallel out shift register, parallel in/Serial out shift register, Bi-directional register.	6
8	**Computer Concepts** Basic Computer System, concepts of hardware and software, Operating Systems, Microcontrollers and Embedded Systems., Digital Signal Processing, Digital Signal Processor (DSP).	6

9	**Memory and Storages** Semiconductor Memory Basics, Types-RAM, ROM, Programmable ROMs, Flash Memory, Memory Expansion, Special Types of Memories, Magnetic and Optical Storage.	5
	Tutorial Tutorials will be based on theory.	16

Reading List:

- Digital Logic and Computer Design, M. M. Mano, PEARSON.
- Digital Computer Electronics: Malvino; Tata McGraw Hill.
- Computer Organization and Design, Patterson and Hennessy
- Computer Structures, Ward andHalstead
- Digital Design: Principles and Practices,Wakerly

Paper Code: MCA703C
Paper Title: Mathematical Foundation (4 Credits, L+T+P = 3+1+0)

The main objective of this course is to introduce the students to Boolean algebra, set theory and graph theory. This course will familiarize the students with the concepts of truth table, syntax and semantics, set,relation, function, various types of graphs and their properties.

The specific learning outcomes are:

1. Boolean algebra, the language that simplifies communication in the world of computers, formal logic, and will be able to reason/infer interesting outcomes; formally prove validity and soundness of a statement.
2. Mathematical structures (sets, relations, functions) and will be able to model real world situations mathematically.
3. The concept of graph viz. connectivity, transitivity related theories and application.
4. The theories and applications related to trees. Understand their properties, classification, minimum spanning properties,separativity etc.
5. Understand planarity of graphs, detection of planarity, thickness and crossing.
6. Understand matrices of graphs and their properties.
7. Understand independence number, clique number, chromatic number, clique number.

Unit	Contents	No. of Lectures
1	**Logic** Propositional Calculus: Alternative styles: Boolean Algebra, truth tables, equational, deduction, Formal systems, Syntax and semantics, Proof theory	5

	and Model theory, consistency and Completeness of different systems.	
2	**Binding Construct** Abstraction of lambda, for all, program function etc.Free and bound variables, substitution.Common laws	3
3	**Set Theory** **D**efinitions, proofs, notations, building models.	3
4	**Well-formed formulae** Ordinary definition, refinement to types, necessity and limitation of computable type checking.	4
5	**Relations** 3 alternative views of foundations of relations: as Cartesian products, as Boolean function (predicates), as power set functions 3 basic types - equivalences, orders, functions.	5
6	**Graph** Definition and examples of graphs, Incidence and degree, Handshaking lemma, Isomorphism, Sub-graphs, Weighted Graphs, Eulerian Graphs, Hamiltonian Graphs, Walks, Paths and Circuits, Connectedness algorithm, Chinese Postman problem, Traveling Salesman problem	8
7	**Trees** Definition and properties of trees, Pendent vertices, centre of a tree, Rooted and binary tree, spanningtrees, minimum spanning tree algorithms, Fundamental circuits, cutsets and cut vertices, fundamental cut sets, connectivity and separativity, max- flowmin-cut theorem.	7
8	**Plane Graphs** Combinatorial and geometric duals, Kuratowski's graphs Detection of planarity, Thickness and crossings.	6
9	**Matrix Representation of Graphs and coloring** Incidence, Adjacency Matrices and their properties, Chromatic Number, Chromatic Polynomial, the six and five color theorems, the four color theorem	7
	Tutorial Tutorials will be based on theory.	16

Reading List:

- Discrete mathematics, S Santha, Cengage learning
- Logic for CS byGallier

- Discrete Math by TremblayManohar
- Discrete Math byStanat
- Laws of Logical Calculi byMorgan
- Computer modeling of mathematical reasoning byBundy
- Predicate Calculus and Program Semantics byDijkstra

Paper Code: MCA704C
Paper Title: Data Structure (4 Credits, L+T+P = 3+0+1)

The main objective of this course is to introduce the students to different data structures, their representation and application. This course will familiarize the students with various applications like arithmetic expression evaluation and conversion. Students will be able to Compare and Analyze efficient data structures for a particular way of solving problems.

The specific learning outcomes are:

1. Explain the concept of different data types, primitive, derived and their representation and application through coding.
2. Apply the concept of ADT and linear and nonlinear data types and their representation.
3. Apply these data types in various applications like arithmetic expression evaluation and conversion.
4. Explain the concept of Graphs and Trees and their real time application.
5. Develop various searching, sorting and hashing techniques.
6. Choose and implement efficient data structures and apply them to solve problems.

Unit	Content	No. of Lectures
1	**ADTs and Views** Data Definition, Data Object, Data Types, Built-in Data Type, Derived Data Type, Data Structureand Implementation, Abstract data types. Array:Data Structure, insertion and deletion in an array, Storage Representation of Arrays, Applications of Arrays, Polynomial Representation Using Arrays, insertion and deletion operations in an array. Linked List: Singly, circular, doubly, doubly & circular. Stack: Representation using array & linked list; operations - push, pop, Applications of stack: recursion. Conversion from infix: to postfix,	10

	evaluation of postfix expression.Queue: Representation using array & linked list; operation - insert, delete; circular queue, deque, priority queue implementation, Applications of Queue	
2	**Trees** Terminologies, traversal algorithms (preorder, postorder, inorder).Implementation of binary search tree, threaded tree (one way & two way), AVL tree balancing, Heap tree,B tree -introduction, operation - insertion, deletion, Introduction to red black tree	10
3	**Graph** **I**ntroduction, Graph Representation, Adjacency Matrix, Adjacency List, Graph Traversals, Depth First Search, Breadth First Search, Spanning trees.	8
4	**Searching and Sorting** Linear search, Binary search, Insertion sort, selection sort, Bubble sort, Merge sort , Heap sort, Quick sort, Radix sort, Complexity analysis of sorting and searching algorithms.	10
5	**Hashing** Hash Tables Applications: Parsers and Parser generators, interpreters, syntax extenders	10
	Tutorial Tutorials will be based on theory.	16
	Practical Students are required to practice the concepts learnt in the theory by implementing the various data structures for different problems with different algorithms. The teacher will devise appropriate weekly lab assignments to help students practice the theoretical concepts of data structure basics. Some indicative list of experiments is given below: 1. Search an element in a two dimensional array. 2. Using iteration and recursion concepts, write programs for finding the element in the array using the Binary search method. 3. Perform following operations on tables using functions only - Addition, Subtraction, Multiplication, Transpose. 4. Use iteration and recursion concepts for quick sort. 5. Implement various operations on strings. 6. Swap two numbers using call by value and call by reference strategies. 7. Implement Linked List, Circular and Doubly Linked Lists and perform operations such as insert, delete, update and reverse.	1 Credit

	8. Implement Stacks and Stack application, Queues 9. Write a program to simulate various sorting and searching algorithms.	

Reading List:

- S. Liptsuz: Data Structure
- M.T. Goodrich, R. Tamassia and D. Mount: Data Structures and Algorithms in C++, John Wiley & Sons, Inc.
- Aho, Hopcroft and Ullman:Data Structures and Algorithms, Addision Wesley Publishing Co.

Paper Code: MCA705C

Paper Title: Database Management Systems (4 Credits, L+T+P = 3+0+1)

The main objective of this course is to introduce the students, the concepts necessary for designing, using and implementing database systems and applications. This course will familiarize the students with core terms, concepts, and tools of relational database management systems. Students will be able to evaluate and justify the database-related design diagrams related to any database project.

The specific learning outcomes are:

1. Define the fundamental concepts necessary for designing, using and implementing database systems and applications.
2. Explain the core terms, concepts, and tools of relational database management systems.
3. Apply the techniques, components and tools of a typical database management system to build a comprehensive database information system.
4. Apply relational algebra, TRC, and SQL to solve queries related to database tables.
5. Compare and contrast all the physical file storage techniques and various facilities provided by database management systems.
6. Evaluate and justify the database-related design diagrams related to any database project.
7. Design ER-diagrams and corresponding schema diagrams for handling database projects.

Unit	Content	No. of Lectures
1	**Basic of Database Management Systems** DBMS objectives and architectures.	3
2	**Data Models** Conceptual model, ER model, object-oriented model, UML Logical data	5

	model, Relational, object oriented, object relational.	
3	**Physical Data Models** Clustered, un-clustered files, indices (sparse and dense), B+ tree, join indices, hash and inverted files, grid files, bulk loading, external sort, time complexities and file selection criteria.	5
4	**Relational Database Design** Schema design, Normalization theory, functional dependencies, higher normal forms, integrity rules, Relational operators.	5
5	**Object Oriented Database Design** Objects, methods, query languages, implementations, Comparison with Relational systems, Object orientation in relational database systems, Object support in current relational database systems, complex object model, implementation techniques.	5
6	**Mapping Mechanism** Conceptual to logical schema, Key issues related to physical schema mapping.	3
7	**DBMS Concepts** ACID Property, Concurrency control, Recovery mechanisms, case study Integrity, Views & Security, Integrity constraints, views management, data security.	4
8	**Query Processing and Query Optimization** Heuristic and rule-based optimizers, cost estimates, Transaction Management.	6
9	**Case Study** Case study for Understanding the transaction processing Concurrency and recovery protocols, query processing and optimization mechanisms through appropriate queries in SQL and PLSQL using one or more of Oracle, PostgreSQL, MySQL, some other Open Source Database Package.	4
10	**Web based data model** XML, DTD, query languages	3
11	**Advanced topics** Other database systems, distributed, parallel and memory resident, temporal and spatial databases.Introduction to data warehousing, On-Line Analytical Processing, Data Mining. Benchmarking related to DBMS packages, database administration. Introduction to Big Data. Recent advances in DatabaseManagement.	5

	Tutorial Tutorials will be based on theory.	16
	Practical Students are required to practice the concepts learnt in the theory for designing, using and implementing database systems using SQL. The teacher will devise appropriate weekly lab assignments to help students practice the theoretical concepts of DBMS basics. Some indicative list of experiments is given below: 1. Creation, altering and dropping of tables and inserting rows into a table (use constraints while creating tables) examples using SELECT command.Queries using ANY, ALL, IN, EXISTS, NOTEXISTS, UNION, INTERSECT, Constraints. 2. Queries using Aggregate functions (COUNT, SUM, AVG, MAX and MIN), GROUP BY, HAVING and Creation and dropping of Views.Queries implementing various joins (left,right,full). Implementation of complex queries: nested queries,subqueries. 3. Queries using Conversion functions (to_char, to_number and to_date), string functions (Concatenation, lpad, rpad, ltrim, rtrim, lower, upper, initcap, length, substr and instr), date functions(Sysdate, next_day, add_months, last_day, months_between, least, greatest, trunc, round, to_char, to_date). 4. i) Creation of simple PL/SQL program which includes declaration section, executable section and exception –Handling section (Ex. Student marks can be selected from the table and printed for those who secured first class and an exception can be raised if no records were found) ii) Insert data into student table and use COMMIT, ROLLBACK and SAVEPOINT in PL/SQL block. 5. Develop a program that includes the features NESTED IF, CASE and CASE expression. 6. Program development using WHILE LOOPS, numeric FOR LOOPS, nested loops using ERROR Handling, BUILT-IN Exceptions, USE defined Exceptions, RAISE-APPLICATION ERROR. 7. Programs development using creation of procedures, passing parameters IN and OUT of PROCEDURES. 8. Program development using creation of stored functions, invoke functions in SQL Statements and write complex functions. 9. Program development using creation of package specification, package bodies, private objects, package variables and cursors and calling stored packages. 10. Develop programs using features parameters in a CURSOR, FOR UPDATE CURSOR, WHERE CURRENT of clause and CURSOR variables.	1 Credit

Reading List:

- Database System Concepts
- An introduction to database systems, C. J.Date
- Database Management Systems, Raghu Ramakrishnan, JohannesGehrke
- Principles of Database Systems Vol. I &Vol II, J. D.Ullman
- Relational Database Index Design and the Optimizers by TapioLahdenm, Michael Leach.

Paper Code: MCA-BRIDGE

Paper Title: Fundamentals of Computer (2 Credits, L+T+P = 1+1+0)

Unit	Content	No. of Lectures
1	**Introduction to Computers** Evolution of Computers, Generation of Computers, Classification of Computers Analog & Digital and Hybrid Computers, Classification of Computers according to size, Supercomputers, Mainframe Computers, Personal Computers (Different Types) and Terminals (Different Types), Characteristics of Computers, Block Diagram of a Digital Computer, types of OS.	3
2	**Number Systems** Introduction to Decimal, Binary, Octal, Hexadecimal number system, Conversion, Simple Addition and Subtraction	3
3	**Programming Concepts** Types of Programming Languages, software, Classification of software, Application software and System Software, Structured Programming, Algorithms and Flowcharts with Examples	4
4	**Input / Output Devices** Input Devices-Keyboard, Mouse, Scanner; Output Devices –Monitor, VDU, Printers, Internet, Multimedia, Computer viruses	3
5	**Memory** Memory Hierarchy, Primary Memory-Volatile and non-volatile memory, RAM and ROM and their types, Secondary Memory-Floppy Disk and Hard	3

	Disk.	
	Tutorial - Tutorials will be based on theory.	16

Reading List:

- P .K. Sinha ,Fundamentals of Computers, BPB Publications
- V. Rajaraman, Fundamentals of Computers, 3rd Edition , PHI Publications
- Computer Today- By Suresh Basandra

Paper Code: MCA 801C

Paper Title: Computational Mathematics (4 Credits, L+T+P = 3+1+0)

The main objective of this course is to introduce the students to matrix, vector space, floating point arithmetic, and differential equations. This course will familiarize the students with the concepts matrix algebra, their operation and geometric significance, vector space, their basis, dimension, linear transformation, differential equation and their solution by numerical method.

The specific learning outcomes are:

1. Matrix algebra, their operation and geometrical significance, eigenvalues and eigenvectors, positive definite matrix.
2. Understand vector space, linear dependence and independence of vectors, orthogonally etc.
3. Computing floating point arithmetic and dealing with different types of errors.
4. Finding numerical solution of differential equations with error analysis.
5. Finding interpolation and approximation solution of non-linear equation(s) and order of convergence.

Unit	Content	No. of Lectures
1	**Matrix** Matrix notation, matrix algebra, matrix operations and their geometric significance, inverse, transpose.	4

2	**Vectors** Vector Spaces and subspaces, linear independence, basis, dimension, linear transformations, four fundamental subspaces.	6
3	**Orthogonality** Orthogonal vectors and subspaces, projections, orthogonal bases, Householdertransform.	6
4	**Eigenvalues and Eigenvectors** Their significance, geometric interpretation, similarity transformation and eigenvalues.	6
5	**Positive Definite Matrices** It's connection to optima and optimization, recognition of positive definite matrix	4
6	**Floating Point Arithmetic** Computing and floating point arithmetic, truncation error, round-off error and its propagation.	4
7	**Differential equation** Numerical solution of differential equation(s) (initial value problem and boundary value problem) leading to solution of difference equations towards error analysis of solution techniques.	6
8	**Linear equation** Numerical solution of linear equations using direct and iterative methods, computation of eigenvalues and eigenvectors.	6
9	**Non-linear equation** Interpolation and approximation solution of non-linear equation(s), fixed point methods, order of convergence	6
	Tutorial Tutorials will be based on theory.	16

Reading List:

- Unified introduction to Linear Algebra, Alan Tucker
- Linear Algebra, Serge Lang
- Elementary Linear Algebra, Howard Anton and ChrisRorres
- Numerical Methods for Scientists and Engineers, Chapra,TMH
- Elements of Numerical Analysis, Peter Henrici, JohnWiley&Sons.

Paper Code: MCA 802C
Paper Title: Operating Systems (4 Credits, L+T+P = 3+0+1)

The main objective of this course is to introduce the students to a layer of software called Operating Systems, whose job is to manage all the devices of a computer system and provide user programs with a simple interface to the hardware. This course will familiarize the students with the concepts of processes, memory management, file management, Input/Output management and the potential problem of deadlocks.

The specific learning outcomes are:

1. Elaborate what operating systems are, what they do and how they are designed and constructed.
2. Define process concepts like process scheduling, inter-process communication, process synchronization and concurrency.
3. Explain different memory management schemes, relate various approaches to memory management and effectiveness of a particular algorithm.
4. Identify different page replacement algorithms to solve problems.
5. Explain how the file system, mass storage and I/O are handled in a modern computer system.
6. Analyze the mechanisms necessary for the protection and security of standalone and distributed computer systems.
7. Determine the concepts learned with case studies of Linux and Windows.

Unit	Content	No. of Lectures
1	**Introduction** Simple computer systems made up of a single processor and single core memory spaces and their management strategies. Operating systems as an extended machine & resource manager, operating systems classification; Operating systems and system calls; Operating systems architecture.	3
2	**Processes** Processes as programs with interpolation environments. Multiprocessing without and with IPC Process Concept, Thread, design issues of thread, user space thread and kernel space thread; Usage of thread; Process states, Operation on Processes - creation and termination. Implementation of process - process table	4
	Process Synchronization Race condition, Critical-Section, mutual exclusion. Solution to race	

3	condition and synchronization: - disabling interrupt, test-and-set-lock, Peterson's solution, semaphore, mutex, monitor, message passing;	6
4	**Scheduling** Basic concepts, preemptive and non-preemptive scheduling, scheduling algorithms; types of scheduling- batch, interactive and real-time; goals of scheduling algorithms. FCFS, SJF, RR, priority, multiple queues, and three-level scheduling.	7
5	**Deadlocks** System model, deadlock characterization, methods for handling deadlocks, deadlock prevention, deadlock avoidance, deadlock detection, recovery from deadlock; banker's algorithm	5
6	**Memory Management** Multiprogramming, address binding (relocation) and protection. swapping, virtual memory - logical versus physical address space,paging, page fault, page table and its entries, demand paging, multi-level page table, TLB, its entries and working; Page replacement algorithms - LRU, optimal, NRU, FIFO, second chance, clock, NFU; Working set; What is segmentation, what are its benefits and drawbacks	6
7	**File System** What is file, file naming, file types(directory, regular, device), sequential access and random access files, file attributes, operations on file, hierarchical directory structure, path name(relative and absolute), operation on directories, disk layout, disk partition, file system layout, disk block allocation-contiguous allocation linked list allocation, FAT, i-nodes, directories in UNIX, file system security; A Simple File System; General Model of a File System; Case study on DOS, Windows 98, Windows NT & Linux.	8
8	**I/O Management** Basic principles and overall structure of I/O management subsystem, Device controllers, layers of the I/O subsystem - interrupt handlers device driver, device independent I/O software and user space I/O software	5
9	**Introduction to Distributed Operating Systems** Architecture designs for computer systems with multiple processors, memories and communication networks. Clocking problem and Lamport's solution.	4
	Tutorial Tutorials will be based on theory.	16
	Practical	

	Students are required to practice the operating systems related concepts learnt in the theory by implementing them . The teacher will devise appropriate weekly lab assignments to help students practice the theoretical concepts of operating systems,system calls,Shell programming,simulation of virtual memory, deadlock etc. Some indicative list of experiments is given below: 1. Simple C programs in Unix platform: Programs using system calls, library function calls to display and write strings on standard output devices and files. 2. Programs using fork system calls. 3. Programs for error reporting using errno, perror( ) function. 4. Programs using pipes. 5. Basic Shell programming. 6. Programs to simulate process scheduling like FCFS, Shortest Job First and Round Robin. 7. Programs to simulate page replacement algorithms like FIFO, Optimal and LRU. 8. Programs to simulate free space management. 9. Programs to simulate virtual memory. 10. Programs to simulate deadlock detection.	1 Credit

Reading List:

- Modern Operating System, Tanenbaum, PHI Publication.
- Operating System by Galvin
- G. Nutt Operating Systems: A Modern Perspective, Pearson Education.
- W. Stallings Operating Systems, Prentice Hall of India.
- Peterson, "Operating System".

Paper Code: MCA 803C

Paper Title: Design and Analysis of Algorithms(4 Credits, L+T+P = 3+0+1)

The main objective of this course is to introduce the students with various paradigms of algorithm design. This course will familiarize the students with analyzing the complexity/ performance of different algorithms. Students will be able to apply important algorithmic design paradigms in solving various computer science problems with appropriate algorithm design techniques

The specific learning outcomes are:

1. To learn techniques and principles of algorithm design;

2. To learn how to analyze algorithms and estimate their worst-case and average case behaviour (in easy cases);
3. Analyze the complexity/ performance of different algorithms. Categorize the different problems in various classes according to their complexity.
4. Choose and implement efficient data structures and apply them to solve problems.
5. Design various searching and sorting techniques.
6. To apply important algorithmic design paradigms in solving various computer science problems with appropriate algorithm design techniques.

Unit	Contents	No. of Lectures
1	**Notion of Algorithms** Fundamentals of Algorithmic Problem Solving – Important Problem Types – Fundamentals of the Analysis of Algorithm Efficiency – Analysis Framework – Asymptotic Notations and its properties – Mathematical analysis for Recursive and Non-recursive algorithms.	8
2	**Divide-and-Conquer and Greedy Method** Traveling Salesman Problem – Knapsack Problem – Assignment problem. Divide and conquer methodology – Merge sort – Quick sort – Binary search – Multiplication of Large Integers – Strassen's Matrix Multiplication.	8
3	**Dynamic Programming and Greedy Technique** Computing a Binomial Coefficient-Warshall "sandFloyd" algorithm– Optimal Binary Search Trees–Knapsack Problem and Memory functions.Greedy Methods with Examples Such as Optimal Reliability Allocation, Knapsack, Minimum Spanning Trees – Prim's and Kruskal's Algorithms, Single Source Shortest Paths – Dijkstra's and Bellman FordAlgorithms.	12
4	**Iterative Improvement** The Simplex Method-The Maximum-Flow Problem – Maximum Matching in Bipartite Graphs.	8
5	**Coping with the Limitations of Algorithm Power** LimitationsofAlgorithmPower- Lower-Bound Arguments-Decision Trees-P, NP and NPCompleteProblems–Coping with the Limitations – Backtracking	12

	– n-Queens problem – Hamiltonian Circuit Problem–Subset Sum Problem-Branchand Bound–Assignment Problem–Knapsack Problem – Traveling Salesman Problem- Approximation Algorithms for NP – Hard Problems – Traveling Salesman problem – Knapsack problem.	
	Tutorial Tutorials will be based on theory.	16
	Practical Students are required to practice the algorithm design related concepts learnt in the theory by implementing them . The teacher will devise appropriate weekly lab assignments to help students practice the theoretical concepts of various algorithm design techniques like divide and conquer, greedy algorithm, Optimization,dynamic programming etc. Some indicative list of experiments is given below: 1. Using Graph notation to prove that bubble sort algorithm has time complexity (n^2). 2. Implement the Dynamic programming technique and analyze the algorithm using the graph notation. 3. Implement the Greedy programming technique and analyze the algorithm using the graph notation. 4. Implement the Divide and Conquer technique and analyze the algorithm using the graph notation. 5. Design a small file compressor and de-compressor by using Huffman coding technique.	1 Credit

Reading List:

- Corman et al.: Introduction to Algorithms, McGrawHill.
- Aho A, Hopcroft J., Ullman J.: The Design and Analysis of Algorithms, Addison-Wesley.

Paper Code: MCA 804C
Paper Title: Computer Networks (4 Credits, L+T+P = 3+0+1)

The main objective of this course is to introduce the students with network topologies, network, transport and application design issues in a network. This course will familiarize the students with TCP from OSI layer protocols, subnetting application layer security. Students will be able to.Analyse the pros, cons and implementation of different IEEE based protocols.

The specific learning outcomes are:

1. Define topology implementing different routing protocols that best suits a real time demand application, network and transport layer.
2. Explain the different network topologies, network, transport and application design issues and the importance of QoS in a network.

3. Solve different problems related to subnetting, configuring working routing protocols in some model network topology and implement presentation layer security.
4. Distinguish TCP from OSI and Analyze different layer protocols, sub-netting application layer security.
5. Judge security protocols required and their workings.
6. Formulate the pros, cons and implementation of different IEEE based protocols.

Unit	Content	No. of Lectures
1	**Introduction to Computer Networks** Uses of Computer Networks; Wired and wireless Networks; Types of networks – LAN, MAN, WAN; Network Topology; OSI Reference Model – Outline, Protocol hierarchies, Design considerations; TCP-IP Reference Model; Comparison among these reference models	5
2	**Physical Layer** Fourier Analysis (Qualitative), Maximum data rate of a Channel, Bit rate and Baud; Baseband and Broadband; Guided Transmission Media- Magnetic, Twisted pair, Coaxial cable, Fibre Optics, Wireless transmission – Electromagnetic Spectrum, Radio transmission, Microwave Transmission, Infrared transmission; Comparison among the different transmission media – guided and unguided.	5
3	**Data Link Layer** Design Issues - Services provided to the higher layer, Framing, Error Control, Flow Control; Error Detection and Correction – Error Correcting Codes, Error-Detecting Codes; Elementary Data Link Protocols – Unrestricted simplex protocol, Simplex stop-and-wait protocol, Protocol for Noisy Channel; Sliding Window protocols – One bit sliding window, Go Back n protocol, Protocol using Selective Repeat.	7
4	**Medium Access Control Sublayer** Random Access Protocols-ALOHA, CSMA, CSMA/CD, CSMA/CA, Controlled Access, Channelization; X.25, ATM, LAN - Ethernet IEEE 802.3 - IEEE 802.4 - IEEE 802.5 - IEEE 802.11.	8
5	**Network Layer** Design Issues – Store and forward packet switching, Services provided to higher layer, Connection Oriented and Connectionless services, Virtual Circuits and Datagram subnets; Routing Algorithms – Shortest Path Routing, Flooding, Distance Vector Routing, Link State Routing, Congestion Control Algorithms – General Principles, Congestion Prevention Policies, Congestion control in Virtual Circuit and Datagram Subnets; Internetworking – Tunneling, Fragmentation; Internet Protocol –	8

	IP addresses, Subnets, CIDR, Network address translation,; Internet Control Protocol – ICMP, ARP, RARP, BOOTP, DHCP.	
6	**Transport layer** Duties of transport layer – Multiplexing – Demultiplexing – Sockets – User Datagram Protocol (UDP) – Transmission Control Protocol (TCP) – Congestion Control – Quality of services (QOS) – Integrated Services.	8
7	**Application Layer** Domain Name System – name space, resource records, name servers; Electronic Mail- architecture and services, user agent, Message formats – MIME, Message Transfer - SMTP, Message Delivery – POP3 and IMAP, Web mail. Cryptography, Substitution Ciphers, Transposition Ciphers, One time pads, Cryptographic principles; Symmetric Key Algorithms – Data Encryption Standard, Public Key Algorithms – RSA.	7
	Tutorial Tutorials will be based on theory.	16
	Practical Students are required to practice the Computer Networks related concepts learnt in the theory by implementing them . The teacher will devise appropriate weekly lab assignments to help students practice the theoretical concepts of various techniques like Socket programming , encryption,Stuffing, Flooding, Broadcastingetc. Some indicative list of experiments is given below: 1. Bit Stuffing and Character Stuffing 2. CRC,CRC-12,CRC-16,CRC-CCIT 3. Dijkstra's Shortest path routing algorithm 4. Distance vector routing algorithm 5. Link state routing algorithm 6. Flooding 7. Broadcasting 8. Congestion control using Leaky bucket algorithm 9. TCP and UDP Socket programming 10. Simple RSA algorithm to encrypt and decrypt the data	1 Credit

Reading List:

- A.S. Tanenbaum: Computer Networks, PHI
- William Stallings, Data and Computer Communications, Pearson Education
- BehrouzForouzan and S.C. Fegan: Data Communications and Networking, McGraw Hill
- W. Tomasi: Introduction to Data Communications and Networking, Pearson Education

- P.C. Gupta, Data Communications and Computer Networks, PHI

Paper Code: MCA 805C
Paper Title: Software Engineering (4 Credits, L+T+P = 3+1+0)

The field of software engineering aims to find answers to the many problems that software development projects are likely to meet when constructing large software systems. The objective of this paper is to make students aware of the problems incurred by large-scale software development and the solutions proposed. It covers a framework for studying and evaluating software tools, and stresses the importance of theory in the development of software

The specific learning outcomes are:

1. Define the life cycle models of software.
2. Explain, identify and differentiate various software life cycle models
3. Experiment with different software architectures and identify the best feasible one
4. Maintain the software project by using a maintenance plan.
5. Analyze and design the software requirement specification
6. Summarize, Evaluate and validate a practical solution towards a software application development and also deploy a product of their own.
7. Develop and create various design diagrams and find solutions to problems.

Unit	Content	No. of Lectures
1	**Basic of Software engineering** Concepts of software management, the software crisis, principles of software engineering, programming in the small Vs programming in the large.	4
2	**Software life cycles** Software methodologies/processes, the software life cycle, the waterfall model and variations, introduction to evolutionary and prototyping approaches.	5
3	**Software requirement analysis** Object-oriented requirements analysis and modelling: requirements analysis, requirements elicitation, analysis tools, requirements definition, requirements specification, static and dynamic specifications, requirements	5

	review.	
4	**Software design** Software design, Design for reuse, design for change, design notations, design evaluation and validation	5
5	**Implementation and testing** Programming standards and procedures, modularity, data abstraction, static analysis, unit testing, integration testing, regression testing, tools for testing, fault tolerance.	8
6	**Maintenance** Maintenance problem, the nature of maintenance, planning for maintenance.	4
7	**Documentation** User Manuals, documentation formats, tools.	2
8	**Project management** Relationship to life cycle, project planning, project control, project organization, risk management, cost models, configuration management, version control, quality assurance,metrics.	8
9	**Capability maturity models** Introduction to Capability Maturity Model, People Capability Maturity Model, Software Acquisition Capability Maturity Model, Systems Engineering Capability Maturity Model.	7
	Tutorial Tutorials will be based on theory.	16

Reading List:

- Software Engineering, Ian Sommerville, Addison Wesley.
- The Engineering of Software, Dick Hamlet, Joe Maybee, AddisonWesley,
- Introduction to the Team Software Process, Watts S. Humphrey, AddisonWesley,
- Software Engineering A Practitioner's Approach European Adaption, 5th Edn.,Roger S. Pressman, adapted by Darrel Ince, McGraw Hill.

Paper Code: MCA E01
Paper Title: Computer Graphics (4 Credits, L+T+P = 3+1+0)

The course introduces the basic concepts of computer graphics. It provides the necessary theoretical background and demonstrates the application of computer science to graphics. The

course further allows students to develop programming skills in computer graphics through programming assignments.

The specific learning outcomes are:

1. Understand the basics of computer graphics, different graphics systems and applications of computer graphics.
2. Understand various algorithms for scan conversion and filling of basic objects and their comparative analysis.
3. Use of geometric transformations on graphics objects and their application in composite form.
4. Extract scene with different clipping methods and its transformation to graphics display device.
5. Explore projections and visible surface detection techniques for display of 3D scenes on 2D screens.
6. Render projected objects to naturalize the scene in 2D View and use of illumination models for this.

Unit	Contents	No. of Lectures
1	**Development of computer Graphics** Raster Scan and Random Scan graphics storages, displays processors and character generators, color display techniques, interactive input/output devices.	9
2	**Points, lines and curves** Scan conversion, line-drawing algorithms, circle and ellipse generation, conic-section generation, polygon filling, anti-aliasing.	10
3	**Transformation** Translation, Rotation, Scaling, Mirror Images, Coordinate system, 3D-Transformation, Rotation about an arbitrary axis, Orthogonal Projections, Multiple Views, Isometric Projection, Perspective Projections (one ,two and three vanishing points), Wire Frame Perspective Depth.	10
4	**Two-dimensional viewing** Co-ordinate systems, linear transformations, line and polygon clipping algorithm.	9
5	**Three-dimensional concepts** 3-D representations, transformations, perspective and parallel projections,	10

	spline curves and surfaces, Hidden Surface and hidden - line removal algorithms, Shading models and color models for solid objects.	
	Tutorial - Tutorials will be based on theory.	16

Reading List:

- Hearn and M. P. Baker, Computer Graphics, PHI.
- J.D. Foley, A van Dam, S.K. Feiner and J.F.Hughes, Computer Graphics: Principles and Practices, Addison-Wesley.
- J.D. Foley and A.D. Van, Fundamentals of Interactive Computer Graphics, Addison-Wesley.
- D.F. Rogers, Procedural Elements for Computer Graphics, McGraw-Hill.

Paper Code: MCA E02

Paper Title: Digital Image Processing (4 Credits, L+T+P = 3+1+0)

The objective of this course is to introduce the concepts of image processing and basic analytical methods to be used in image processing. To familiarize students with image enhancement and restoration techniques, to explain different image compression techniques. To introduce segmentation and morphological processing techniques.

The specific learning outcomes are:

1. Explain the fundamentals of digital image and its processing
2. Perform image enhancement techniques in spatial and frequency domain.
3. Elucidate the mathematical modeling of image restoration and compression
4. Apply the concept of image segmentation.
5. Describe object detection and recognition techniques.

Unit	Content	No. of Lectures
1	**Introduction** Image Acquisition, Image Model, Sampling, Quantization, Basic relationship between pixels, distance measures, connectivity, Image Geometry, Photographic film. Histogram: Definition, decision of contrast basing on histogram, operations basing on histograms like image stretching, image sliding, Image classification, Definition and Algorithm of Histogram equalization. Image Transforms: A detail discussion on Fourier Transform, DFT, FFT,	10

	properties. A brief discussion on WALSH Transform, WFT, HADAMARD Transform, DCT.	
2	**Image Enhancement** SPATIAL Domain Methods: Arithmetic and logical operations, pixel or point operations, size operations, Smoothing filters-Mean, Median, Mode filters. Edge enhancement filters – Directorial filters, Sobel, Laplacian, Robert, KIRSCH Homogeneity & DIFF Filters, Prewitt filter, Contrast Based edge enhancement techniques. Low Pass filters, High Pass filters, sharpening filters, Color image processing. FREQUENCY Domain Methods: Design of Low pass, High pass, EDGE Enhancement, smoothing filters in Frequency Domain. Butter worth filter, Homomorphic filters in Frequency Domain. Advantages of filters in frequency domain, comparative study of filters in frequency domain and spatial domain.	12
3	**Image Compression** Definition, A brief discussion on – Run length encoding, contour coding, Huffman code, compression due to change in domain, compression due to quantization Compression at the time of image transmission. Brief discussion on- Image Compression standards.	8
4	**Image Segmentation and Representation** Definition, characteristics of segmentation. Detection of Discontinuities, Thresholding Pixel based segmentation method. Region based segmentation methods – segmentation by pixel aggregation, segmentation by sub region aggregation, histogram based segmentation, split and merge technique. Use of motion in segmentation (spatial domain technique only) Boundary representation: chair codes- Polygonal approximation – Boundary segments boundary descriptors: Simple descriptors-Fourier descriptors- Regional descriptors- Simple descriptors Texture.	10
5	**Morphological Image Processing** Dilation, Erosion, Opening, Closing, Hit-and-Miss transform, Boundary extraction, Region filling, connected components, thinning, Thickening, skeletons, Pruning Extensions to Gray – Scale Images. Application of Morphology in Image Processing.	8
	Tutorial Tutorials will be based on theory.	16

Reading List:

- Digital Image Processing by Rafael C. Gonzalez and Richard E. Woods.
- Image Processing, Analysis and Machine Vision by Milan Sonka, Vaclav Hlavac and Roger Boyle.
- Fundamentals of Digital Image Processing by Anil K. Jain

Paper Code: MCA E03

Paper Title: Advanced Database Management System (4 Credits, L+T+P = 3+1+0)

The objective of this course is to develop your knowledge and understanding of the underlying principles ofRelational Database Management System, build up your capacity to learn Database Management System advanced features, develop your competence in enhancing database models using distributed databases and build up your capacity to implement and maintain an efficient database system using emerging technologies and tools.

The specific learning outcomes are:

1. Describe the basic concepts of Relational Database Design.
2. Explain Database implementation and tools.
3. Describe SQL and Database System catalog.
4. Describe the process of DB Query processing and evaluation.
5. Discuss the concepts of transaction management.
6. Explain Database Security and Authorization.
7. Describe the design of Distributed Databases.
8. Know how to design a Database and XML.
9. Describe the basic concept of Data warehousing and Data mining.
10. Discuss the emerging Database Models, Technologies and Applications.

Unit	Content	No. of Lectures
	Relational Database Design	

1	Features of good database design, Enhanced ER tools :Subclasses, Super class, and Inheritance ,Specialization and Generalization, Constraints and Characteristics of Specialization and Generalization, Converting EER diagram to tables, Use of UML and its support for database design specifications, Representing specialization and generalization in UML Class diagram, Functional dependency theory and normalization, Multi value dependency and 4NF,Join Dependency and 5NF, Inclusion Dependencies and Template Dependency, PJNF/DKNF.	11
2	**Advanced SQL** Assertion and views, Cursors, triggers and stored procedures ,Embedded SQL, dynamic SQL, SQLJ, Advanced Features of SQL	9
3	**Transaction Management and Recovery** Advanced feature of Transactions, Enhanced Lock Based and timestamp based Protocols, Multiple Granularity, Multi-version Schemes, Deadlock Handling, Weak Levels of Consistency, Concurrency in Index Structures, Recovery and Atomicity, Recovery with Concurrent Transaction, Buffer Management.	10
4	**Database Security, Authorization and Distributed Databases** Levels of database security,Accesscontrol,Multilevel security, Statistical database security, Audit trails in the databases, Examples of e security,Centralized versus non centralized Databases,Homogeneous and Heterogeneous DDBMS and their comparison,Functions and Architecture,Distributed database design, query processing in DDBMS,Distributed concurrency management, deadlock management,Distributed Commit Protocols: 2 PC and 3 PC, Concepts of replication servers.	10
5	**Emerging Database Models** Object Oriented Database, Multimedia database, Geography databases, Gnome databases, Knowledge databases, Semantic databases, Spatial database, Mobile databases, Web databases.	8
	Tutorial Tutorials will be based on theory.	16

Reading List:

- Fundamentals of Database Systems by R. Elmasri and S. Navathe, Pearson ,Addison Wesley.
- Foundations of Databases by Serge Abiteboul, Richard Hull and Victor Vianu, Addison-Wesley Longman Publishing Co.
- Database System Concepts by Abraham Silberschatz, Henry Korth, and S. Sudarshan, McGraw Hill Education.

Paper Code: MCA E04

Paper Title: Graph Theory and its Applications (4 Credits, L+T+P = 3+1+0)

The objective of this course is to understand and apply the fundamental concepts in graph theory and to apply graph theory based tools in solving practical problems.

The specific learning outcomes are:

1. Understand in depth and tell all the basic terms of graph theory.
2. Integrate core theoretical knowledge of graph theory to solve problems.
3. Reason from definitions to construct mathematical proofs.
4. Analyze new networks using the main concepts of graph theory.

Unit	Content	No. of Lectures
1	**Graph** Incidence and degree; Handshaking Lemma; Isomorphism; Sub graphs and Union of graphs; Connectedness; Walks, Paths and Circuits; Components and Connectedness; Walks, Paths and Circuits; Components and Connectedness algorithms; Shortest Path Algorithms, Eulerian graph, Fleury's algorithm and Chinese postman problem; Hamiltonian graph - necessary and sufficient conditions; Travelling salesman; Bipartite graph.	8
2	**Tree** Properties of trees; Pedant vertices in a tree; Centre of a tree; Rooted binary trees; Spanning trees - Spanning tree algorithms; Fundamental circuits; Spanning trees of a weighted graph; cut-sets and cut-vertices; Fundamental cut-sets; Connectivity and separativity; network flow; max-flow min-cut theorem.	6
3	**Planar graph** Combinatorial and geometric duals; Kuratowski's graph; detection of planarity; Thickness and crossings	5
4	**Matrix Representations of Graph** Incidence; Adjacency; matrices and their properties Colorings: Chromatic number: Chromatic polynomial; The six and five color theorems; The four color problem.	8
5	**Directed Graphs** Binary relations; Directed graphs and connectedness; directed trees; Aborecence;	5

	Polish method; Tournaments.	
6	**Counting of Labeled Trees** Cayley's theorem; Counting methods; Polya theory. Switching and coding theory and VLSI design	8
7	**Application and Implementation of Different Algorithm** Application: Application of Graph theory in different fields. Implementation: Hamiltonian path problem, Eularian path problem, Shortest path problem,TSP, Coloring Problem, Fleury's algorithm and Chinese postman problem	8
	Tutorial Tutorials will be based on theory.	16

Reading List:

- Deo, N, Graph theory with applications to Engineering and Computer Science, PHI
- Gary Chartrand and Ping Zhang, Introduction to Graph Theory, TMH
- Robin J. Wilson, Introduction to Graph Theory, Pearson Education
- Harary, F, Graph Theory, Narosa

Paper Code: MCA E05

Paper Title: Computer Oriented Numerical Methods and Statistical Techniques

(4 Credits, L+T+P = 3+1+0)

The main objective of this course is to understand and implement various concepts of numerical analysis and statistics to solve real life problems.

The specific learning outcomes are:

1. Understand the various approaches dealing with the data using theory of probability.
2. Analyze the different samples of data at different levels of significance using various hypothesis testing.
3. Develop a framework for estimating and predicting the different samples of data forhandling the uncertainties.
4. Understand error, source of error and its effect on any numerical computation and also analyze the efficiency of any numerical algorithm.
5. Learn how to obtain numerical solutions of nonlinear equations using Bisection, Newton –Raphson and fixed-point iteration methods.
6. Solve a system of linear equations numerically using direct and iterative methods.

7. Understand the methods to construct interpolating polynomials.

Unit	Contents	No. of Lectures
1	**Representation of numbers** Floating point representation, single and double precision, round off errors and truncation errors.	4
2	**Solution of Non-linear Equation** Bisection method, Newtons method, Regula Falsi method, secant method, fixed point algorithm.	8
3	**Solution of Simultaneous Linear Equation** Basic elimination method, Gaussian elimination method, Gauss Jordan method, method of successive approximation.	7
4	**Ordinary Differential Equation** Euler's method, RungeKutta method, Milne's method**.**	7
5	**Interpolation** Newton's interpolation, Lagrange's interpolation, Newton's divided difference method**.**	7
6	**Numerical integration** Trapezoidal rule, Simpson rule, Newton's Cotes method.	8
7	**Statistical Methods** Measure of central tendency: Mean,Median and Mode. Probability, probability distribution, Binomial, Poison and normal distribution. Mathematical expectations, moments, correlation, regression.	7
	Tutorial Tutorials will be based on theory.	16

Reading List:

- M.K.Jain, S.R.K.Iyenger, R.K.Jain, " Numerical methods for Scientific and Engineering Computation", Wiley Easterns.
- K.E. Atkinson, "An introduction to numerical analysis", J.Willey and Sons.

Paper Code: MCA E06

Paper Title: Distributed Computing (4 Credits, L+T+P = 3+1+0)

The main objective of this course is to provide hardware and software issues in modern distributed systems, to get knowledge in distributed architecture, naming, synchronization, consistency and replication, fault tolerance, security, and distributed file systems.

The specific learning outcomes are:

1. Provide hardware and software issues in modern distributed systems.
2. Get knowledge in distributed architecture, naming, synchronization, consistency and replication, fault tolerance, security, and distributed file systems.
3. Know about Shared Memory Techniques.
4. Have sufficient knowledge about file access.
5. Have knowledge of Synchronization and Deadlock.

Unit	Content	No. of Lectures
1	**Characterization of Distributed Systems** Introduction, Examples of distributed Systems, Resource sharing and the Web Challenges. Architectural models, Fundamental Models. Theoretical Foundation for Distributed System: Limitation of Distributed system, absence of global clock, shared memory, Logical clocks, Lamport's& vectors logical clocks. Concepts in Message Passing Systems: causal order, total order, total causal order, Techniques for Message Ordering, Causal ordering of messages, global state, and termination detection.	10
2	**Distributed Mutual Exclusion** Classification of distributed mutual exclusion, requirement of mutual exclusion theorem, Token based and non-token based algorithms, performance metric for distributed mutual exclusion algorithms. Distributed Deadlock Detection: system model, resource vs. communication deadlocks, deadlock prevention, avoidance, detection & resolution, centralized deadlock detection, distributed deadlock detection, path pushing algorithms, edge chasing algorithms.	10
3	**Agreement Protocols** Introduction, System models, classification of Agreement Problem, Byzantine agreement problem, Consensus problem, Interactive consistency Problem, Solution to Byzantine Agreement problem, Application of	10

	Agreement problem, Atomic Commit in Distributed Database system. Distributed Resource Management: Issues in distributed File Systems, Mechanism for building distributed file systems, Design issues in Distributed Shared Memory, Algorithm for Implementation of Distributed Shared Memory.	
4	**Failure Recovery in Distributed Systems** Concepts in Backward and Forward recovery, Recovery in Concurrent systems, obtaining consistent Checkpoints, Recovery in Distributed Database Systems. Fault Tolerance: Issues in Fault Tolerance, Commit Protocols, Voting protocols, Dynamic voting protocols.	8
5	**Transactions and Concurrency Control** Transactions, Nested transactions, Locks, Optimistic Concurrency control, Timestamp ordering, Comparison of methods for concurrency control. Distributed Transactions: Flat and nested distributed transactions, Atomic Commit protocols, Concurrency control in distributed transactions, Distributed deadlocks, Transaction recovery. Replication: System model and group communication, Fault - tolerant services, highly available services, Transactions with replicated data.	10
	Tutorial Tutorials will be based on theory.	16

Reading List:

- Singhal & Shivaratri, "Advanced Concept in Operating Systems", McGraw Hills.
- Coulouris, Dollimore, Kindberg, "Distributed System: Concepts and Design", Pearson Education.
- Tennenbaum, Steen," Distributed Systems", PHI

Paper Code: MCA E07

Paper Title: Mobile Computing (4 Credits, L+T+P = 3+1+0)

This course will help the students to develop an understanding of the ways that mobile technologies can be used for teaching and learning. They will also consider the impact of mobile computing on the field of education.

The specific learning outcomes are:

1. Understand concepts of Mobile Communication.

2. Analyze the next generation Mobile Communication System.
3. Understand network and transport layers of Mobile Communication.
4. Analyze various protocols of all layers for mobile and adhoc wireless communication networks.
5. Understand IP and TCP layers of Mobile Communication. .

Unit	Content	No. of Lectures
1	**Introduction to Mobile Communications and Computing** Introduction to Mobile Computing, novel applications, limitations, and architecture. GSM: Mobile services, System architecture, Radio interface, Protocols, Localization and calling, Handover, Security, and New data services.	8
2	**Medium Access Control** Motivation for a specialized MAC (Hidden and exposed terminals, Near and far terminals), SDMA, FDMA, TDMA, CDMA.	8
3	**Mobile Network Layer** Mobile IP (Goals, assumptions, entities and terminology, IP packet delivery, agent advertisement and discovery, registration, tunneling and encapsulation, optimizations), Dynamic Host Configuration Protocol (DHCP).	8
4	**Mobile Transport Layer** Traditional TCP, Indirect TCP, Snooping TCP, Mobile TCP, Fast retransmit/fast recovery, Transmission /time-out freezing, Selective retransmission, Transaction oriented TCP.	8
5	**UNIT V: Mobile Ad hoc Networks (MANETs)** Overview, Properties of a MANET, spectrum of MANET applications, routing and various routing algorithms, security in MANETs.	8
	Protocols and Tools Wireless Application Protocol-WAP (Introduction, protocol architecture),	

6	Bluetooth (User scenarios, physical layer, MAC layer, networking, security, link management) and J2ME.	8
	Tutorial Tutorials will be based on theory.	16

Reading List:

- Jochen Schiller, "Mobile Communications", Addison-Wesley, second edition, 2004.
- Stojmenovic and Cacute, "Handbook of Wireless Networks and Mobile Computing", Wiley, 2002.
- RezaBehravanfar, "Mobile Computing Principles: Designing and Developing Mobile Applications with UML and XML",Cambridge University Press, October 2004.

Paper Code: MCA E08

Paper Title: Network Security and Cryptography (4 Credits, L+T+P = 3+1+0)

The objective of this course is to understand the basics of Cryptography and Network Security. To learn about how to maintain the Confidentiality, Integrity and Availability of data. To understand various protocols for network security to protect against the threats in the networks.

The specific learning outcomes are:

1. Secure a message over an insecure channel by various means.
2. Perform research in the emerging areas of cryptography and network security.
3. Implement various networking protocols.
4. Identify, explain, and apply cryptographic techniques like key management, digital signatures, digital certificates, and a Public-Key Infrastructure (PKI) to various disciplines in information science.

Unit	Content	No. of Lectures
1	**Introduction to the concepts of Security** Introduction, The Need for Security, Security approaches, Principles of Security, Types of Attacks. Cryptographic Techniques: Introduction, Plain Text and Cipher Text, Substitution Techniques, Transposition Techniques, Encryption and Decryption, Symmetric and Asymmetric Key Cryptography, Steganography, Key Range and Key Size, Possible Types of attacks.	12

2	**Computer Based Symmetric Key Cryptographic Algorithms** Introduction, Algorithm Types and modes, An Overview of Symmetric Key Cryptography, Data Encryption Standard (DES), International Data Encryption Algorithm (IDEA), RC5, Blowfish, Advanced Encryption Standard (AES), Differential and Linear Cryptanalysis. Computer Based Asymmetric Key Cryptographic Algorithms: Introduction, Brief history of Asymmetric Key Cryptography, An Overview of Asymmetric Key Cryptography, the RSA Algorithm, Symmetric and Asymmetric Key Cryptography Together, Digital Signatures, Knapsack Algorithm.	12
3	**Public Key Infrastructure** Introduction, Digital Certificates, Private Key Management, the PKIX, Public Key Cryptography Standards (PKCS) XML, PKI and Security. Internet Security Protocols: Basic Concepts, Secure Socket Layer (SSL), Secure Hyper Text Transfer Protocols (SHTTP), Time Stamping Protocol (TSP), Secure Electronic Transaction (SET), SSL versus SET, 3-D Secure Protocol, Electronic money, Email Security, Wireless Application Protocol (WAP), Security in GSM.	12
4	**User Authentication Mechanisms** Introduction, Authentication Basics, Passwords, Authentication Tokens, Certificate-based Authentication, Biometric Authentication, Kerberos. Network Security: Brief Introduction to TCP/IP, Firewalls, IP Security, Virtual Private Networks (VPN)	12
	Tutorial Tutorials will be based on theory.	16

Reading List:

- BruceSchneier, Applied cryptography: protocols, algorithms, and source code in C, John Wiley & Sons
- A. Kahate, Cryptography and Network Security, PHI.
- W. Stallings, Cryptography and Network Security, PHI.
- B. A. Forouzan, Cryptography and Network Security, McGraw Hill.
- W. Stallings, Network Security Essentials: Applications and Standards, Pearson.

Paper Code: MCA E09

Paper Title: Data Mining (4 Credits, L+T+P = 3+1+0)

This course will introduce students to the concepts and techniques of data mining, develop skills of using recent data mining software for solving practical problems, study the methodology of engineering legacy databases for data warehousing and data mining to derive business rules for decision support systems, develop and apply critical thinking, problem-solving, and decision-making skills.

The specific learning outcomes are:

1. Understand data mining principles and techniques and acquaint the students with the data mining techniques for building competitive advantage through proactive analysis, predictive modeling, and identifying new trends and behaviors.
2. Learn how to gather and analyze large sets of data to gain useful business understanding.
3. Produce a quantitative analysis report/memo with the necessary information to make decisions.
4. Describing and demonstrating basic data mining algorithms, methods, and tools.
5. Identifying business applications of data mining
6. Overview of the developing areas - web mining, text mining, and ethical aspects of data mining.

Unit	Contents	No. of Lectures
1	**Overview** The process of knowledge discovery in databases, predictive and descriptive data mining techniques, supervised and unsupervised learning techniques. Techniques of Data Mining: Link analysis, predictive modeling, database segmentation, score functions for data mining algorithms, Bayesian techniques in data mining. Issues in Data Mining: Scalability and data management issues in data mining algorithms, parallel and distributed data mining, privacy, social, ethical issues in KDD and data mining, pitfalls of KDD and data mining. Applications: Application and trends in Data Mining: Data Mining Application, Data Mining system products and research prototypes, additional themes on data mining and social impacts of Data Mining.	8
2	**Clustering** Partitional versus Hierarchical Clustering, types of data in clustering. Partitional clustering methods – k-means, k-medoids, PAM,CLARA, CLARANS.Hierarchical clustering methods – BIRCH, CURE. Density based clustering methods- DBSCAN. Categorical clustering – ROCK,	12

	QROCK.	
3	**Rule Mining** Definition, Mining association rules, frequent sets and border sets, algorithms for mining association rules – Apriori algorithm, Pincer-Search algorithm, Border algorithm. Generalized association rule, quantitative association rule, association rule with item constraint. Decision Trees: Introduction, tree construction principle, decision tree generation algorithms – CART, ID3.	12
4	**Data Warehousing** Introduction to Data warehousing, Architecture, Dimensional data modeling- star, snowflake; schemas, fact constellation, OLAP and data cubes, Operations on cubes; Data preprocessing -need for preprocessing, data cleaning, data integration and transformation, data reduction	8
5	**Information Retrieval & XML data** Introduction to information retrieval, Indexing for Text search, Web search engines, Managing text in DBMS, Data model for XML, XML DTD's, Domain specific DTD's, Querying XML data	8
	Tutorial Tutorials will be based on theory.	16

Reading List:

- A. K. Puzari, Data Mining Techniques, University Press.
- J. Han and M. Kamber. Data Mining: Concepts and Techniques. Morgan Kaufman. 2001.
- P. Tan, M. Steinbach and V. Kumar; Introduction to Data Mining; Pearson Education (LPE); 2009.

Paper Code: MCA E10
Paper Title: Optimization Techniques (4 Credits, L+T+P = 3+1+0)

This course will introduce the students to enumerate the fundamental knowledge of Linear Programming and Dynamic Programming problems, learn classical optimization techniques and numerical methods of optimization, know the basics of different evolutionary algorithms, explain Integer programming techniques and apply different optimization techniques to solve various models arising from engineering areas.

The specific learning outcomes are:

1. Explain the fundamental knowledge of Linear Programming and Dynamic Programming problems.
2. Use classical optimization techniques and numerical methods of optimization.
3. Enumerate fundamentals of Integer programming technique and apply different techniques to solve various optimization problems arising from engineering areas.

Unit	Content	No. of Lectures
1	**Introduction and Classical Optimization Techniques** Statement of an Optimization problem - design vector - design constraints - constraint surface - objective function - objective function surfaces - classification of Optimization problems.	4
2	**Classical Optimization Techniques** Single variable Optimization - multi variable Optimization without constraints - necessary and sufficient conditions for minimum/maximum - multivariable Optimization with equality constraints. Solution by method of Lagrange multipliers - multivariable Optimization with inequality constraints - Kuhn - Tucker conditions.	4
3	**Linear Programming** Standard form of a linear programming problem - geometry of linear programming problems - definitions and theorems - solution of a system of linear simultaneous equations - pivotal reduction of a general system of equations - motivation to the simplex method - simplex algorithm.	8
4	**Transportation Problem** Finding initial basic feasible solutions by north - west corner rule, least cost method and Vogel's approximation method - testing for optimality of balanced transportation problems.	4
5	**Unconstrained Nonlinear Programming** One - dimensional minimization methods: Classification, Fibonacci method and Quadratic interpolation method	4
6	**Unconstrained Optimization Techniques** Univariate method, Powell's method and steepest descent method.	8
7	**Constrained Nonlinear Programming** Characteristics of a constrained problem, Classification, Basic approach of	8

	Penalty Function method; Basic approaches of Interior and Exterior penalty function methods. Introduction to Convex Programming Problem.	
8	**Dynamic Programming** Dynamic programming multistage decision processes - types - concept of sub optimization and the principle of optimality - computational procedure in dynamic programming - examples illustrating the calculus method of solution - examples illustrating the tabular method of solution.	8
	Tutorial Tutorials will be based on theory.	16

Reading List:

- Engineering optimization: Theory and practice by S. S.Rao, New Age International (P) Limited, 3rd edition, 1998.
- Introductory Operations Research by H.S. Kasene & K.D. Kumar, Springer (India), Pvt .Ltd.
- Optimization Methods in Operations Research and systems Analysis by K.V. Mital and C. Mohan, New Age International (P) Limited, Publishers, 3rd edition, 1996.
- Operations Research by Dr. S.D.Sharma.

Paper Code: MCA E11

Paper Title: Parallel Algorithm (4 Credits, L+T+P = 3+1+0)

This course will introduce the students to learn about parallel computing models, design and analyze parallel algorithms.

The specific learning outcomes are:

1. Design and analyze parallel algorithms.
2. Analyze performance and measures using various metrics.
3. Apply various graph algorithms in real-life problems.

Unit	Content	No. of Lectures

1	**Introduction to Parallel Algorithm and Models** Sequential model, need of alternative model, parallel computational models such as PRAM, LMCC, Hypercube, Cube Connected Cycle, Butterfly, Perfect Shuffle Computers, Tree model, Pyramid model, Fully Connected model, PRAM-CREW, EREW models, simulation of one model from another one.	12
2	**Performance and Measures** Performance Measures of Parallel Algorithms, speed-up and efficiency of PA, Cost-optimality, An example of illustrate Cost- optimal algorithms-such as summation, Min/Max on various models.	8
3	**Sorting and Merging** Parallel Sorting Networks, Parallel Merging Algorithms on CREW/EREW/MCC/, Parallel Sorting Networks on CREW/EREW/MCC/, linear array.	8
4	**Parallel Searching** Kth element, Kth element in X+Y on PRAM, Parallel Matrix Transportation and Multiplication Algorithm on PRAM, MCC, Vector-Matrix Multiplication, Solution of Linear Equation, Root finding.	12
5	**Graph Algorithms** Connected Graphs, search and traversal, Combinatorial Algorithms Permutation, Combinations, Derangements.	8
	Tutorial Tutorials will be based on theory.	16

Reading List:

- M.J. Quinn, "Designing Efficient Algorithms for Parallel Computer" by Mc Graw Hill
- S.G. Akl, "Design and Analysis of Parallel Algorithms"
- S.G. Akl, "Parallel Sorting Algorithm" by Academic Press

Paper Code: MCA E12

Paper Title: Information Storage and Retrieval (4 Credits, L+T+P = 3+1+0)

The course provides detailed knowledge, practical training and insight into the implementation and management of various storage technologies with a focus towards applying these technologies in an information lifecycle paradigm. This course covers the evolution of storage and implementation models, storage devices principles including structure, host I/O processing, & core algorithms, storage classes (SAN, NAS, CAS), interconnection protocols, and management principles, storage network design principles, networked storage capabilities (Snaps, mirroring, virtualization), backup, business continuity, and disaster recovery principles.

The specific learning outcomes are:

1. Search, retrieve and synthesize information from a variety of systems and sources.
2. Evaluate systems and technologies in terms of quality, functionality, cost-effectiveness and adherence to professional standards.
3. Integrate emerging technologies into professional practice.
4. Apply theory and principles to diverse information contexts.

Unit	Content	No. of Lectures
1	**Introduction to Storage Technology** Data proliferation, evolution of various storage technologies, Overview of storage infrastructure components, Information Lifecycle Management, Data categorization.	8
2	**Storage Systems Architecture** Intelligent disk subsystems overview, Contrast of integrated vs. modular arrays, Component architecture of intelligent disk subsystems, Disk physical structure components, properties, performance, and specifications, RAID levels & parity algorithms, hot sparing, Front end to host storage provisioning, mapping and operation.	8
3	**Introduction to Networked Storage** JBOD, DAS, NAS, SAN & CAS evolution and comparison. Applications, Elements, connectivity, standards, management, security and limitations of DAS, NAS, CAS & SAN.	10
4	**Hybrid Storage Solutions** Virtualization: Memory, network, server, storage & appliances. Data center concepts & requirements, Backup & Disaster Recovery: Principles Managing & Monitoring: Industry management standards (SNMP, SMI-S, CIM), standard framework applications, Key management metrics (Thresholds, availability, capacity, security, performance).	10

5	**Information Storage on Cloud** Concept of Cloud, Cloud Computing, Storage on Cloud, Cloud Vocabulary, Architectural Framework, Cloud benefits, Cloud computing Evolution, Applications & services on cloud, Cloud service providers and Models, Essential characteristics of cloud computing, Cloud Security and integration.	12
	Tutorial Tutorials will be based on theory.	16

Reading List:

- G. Somasundaram & Alok Shrivastava (EMC Education Services) editors; Information Storage and Management: Storing, Managing, and Protecting Digital Information; Wiley India.
- UlfTroppens, Wolfgang Mueller-Friedt, Rainer Erkens, Rainer Wolafka, Nils Haustein; Storage Network explained : Basic and application of fiber channels, SAN, NAS, iSESI, INFINIBAND and FCOE, Wiley India.
- John W. Rittinghouse and James F. Ransome; Cloud Computing : Implementation , Management and Security, CRC Press, Taylor Frances Pub.
- Nick Antonopoulos, Lee Gillam; Cloud Computing : Principles, System & Application.

Paper Code: MCA E13

Paper Title: Web Technology (4 Credits, L+T+P = 3+0+1)

The objective of this course is to make students familiar with client server architecture and they will be able to develop a web application using java technologies. Students will gain the skills and project-based experience needed for entry into web application and development careers.

The specific learning outcomes are:

1. Develop a dynamic webpage by the use of javascript and DHTML.
2. Write a well formed/valid XML document.
3. Connect a java program to a DBMS and perform insert, update and delete operations on the DBMS table.

4. Write a server side java application called Servlet to catch form data sent from the client, process it and store it on the database.
5. Write a server side java application called JSP to catch formdata sent from the client and store it on the database.

Unit	Content	No. of Lectures
1	**BOOTSTRAP** Introduction,Typography,tables,images,Jumbotron,Wells,Alerts,Buttons, Badges,List,groups,Navbar,Themes,Grid System.	7
2	**PHP** Introduction to PHP, Environment, syntax overview, variable types, constants, operator types,decision making, loop types,arrays,strings,web concepts, GET & POST,file Inclusion, files,I/O,Functions,Cookies,Sessions,Sending mails, File uploading, coding standard.	12
3	**ADVANCED PHP** Predefined Variables, Regular Expression, Error Handling, Bugs Debugging, Date & Time, PHP & MySQL,PHP & AJAX, PHP & XML,Object Oriented,PHP Function reference,Built-in Functions, connection to database, selecting a db, building & sending query, retrieving, updating and inserting data	9
4	**JSP** Introduction, Life cycle of JSP JSP-API JSP in Eclipse, scripting elements, scriplet tag JSP expression tag JSP , declaration tag, implicit Objects, SP Request JSP Response JSP Config JSP, page JSP Exception, Directive Elements, taglib directive, JSP Exception, Action Elements	11
5	**ADVANCED JSP** JSP:forward jsp:include java Bean class,VC in JSP,JSTL,Custom tags. Example of Custom Tag Attributes Iteration, Custom URI, Development in JSP,Registration Form, Login Form, Uploading File, Downloading File.	9
	Tutorial Tutorials will be based on theory.	16
	Practical-	

	1. Create a registration form which contains fields name, RollNo, Gender and a submit button. You need to validate all the fields of the form, using JavaScript and use My Sql to save and retrieve data. All the details of the input form should be displayed in the server page when the user clicks the submit button. 2. Using PHP print a "Hello World" message in the Web browser. 3. Using PHP calculate the sum of numbers collected from a user. 4. Using PHP to display the current date and the session Id. 5. Write PHP code for welcoming the user to Online Banking Website. 6. Using PHP displays the hostname and the path of the PHP file. 7. Create a PHP page that passes three parameters to another PHP page. In addition, override request parameters when a PHP page is called. Specify the three parameters as param1,param2 and param3. 8. Using JSP print a "Hello World" message in the Web browser. 9. Using JSP to display the current date and the session Id. 10. Write JSP code for welcoming the user to Online Banking Website. 11. Using JSP displays the hostname and the path of the JSP file. 12. Create a JSP page that passes three parameters to another JSP page. In addition, override a request parameter when a JSP page is called. Specify the three parameters as param1, param2 and param3. 13. Create a struts-blank.war blank application. Use the blank application to create a Web page that displays the title and author of a book. The page includes a Submit button. After the user clicks the Submit button, a page should appear indicating that the request is being processed. The example requires two JSP pages and two JavaBeans. Update struts-config.xml file to associate the Web pages with the JavaBeans.	1 Credit

Reading List:

- E-Commerce Fundamentals & Application, Wiley publications
- Teach Yourself PERL in 21 days, Pearson Education.
- Robert W. Sebesta: Programming the World Wide Web
- Ivan Bayross: Web enabled commercial application development using HTML, DHTML, JavaScript, PERL-CGI
- Dustine R. Callway: Inside Servlets
- James Goodwill: Developing Java Servlets

Paper Code: MCA E14

Paper Title: Cloud Computing (4 Credits, L+T+P = 3+1+0)

The objective of this course is to provide the comprehensive and in-depth knowledge of Cloud Computing concepts, technologies, architecture and applications by introducing and researching state-of-the-art in Cloud Computing fundamental issues, technologies, applications and implementations. Another objective is to expose the students to frontier areas of Cloud Computing and information systems, while providing sufficient foundations to enable further study and research.

The specific learning outcomes are:

1. Articulate the main concepts, key technologies, strengths, and limitations of cloud computing and the possible applications of cloud computing.
2. Identify the architecture and infrastructure of cloud computing, including SaaS, PaaS, IaaS, public cloud, private cloud, hybrid cloud, etc.
3. Explain the core issues of cloud computing such as security, privacy, and interoperability.
4. Choose the appropriate technologies, algorithms, and approaches for the related issues.
5. Identify problems, and explain, analyze, and evaluate various cloud computing solutions.

Unit	Content	No. of Lectures
1	**Introduction** Defining the Cloud, The Emergence of Cloud Computing, Cloud-Based Services, Grid Computing or Cloud Computing, Components of Cloud Computing, Cloud Computing Deployment Models: Public, Private, Hybrid, Benefits of Using a Cloud Model, Legal Issues in Using Cloud Models, Characteristics of Cloud Computing, Evolution of Cloud Computing, Challenges for the Cloud computing, Grid Computing, Distributed Computing in Grid and Cloud.	12
2	**Cloud Service Models** Communication-as-a-Service (CaaS): Advantages of CaaS, Fully Integrated, Enterprise-Class Unified Communications, Infrastructure-as-a-Service (IaaS): Modern On-Demand Computing, Amazon's Elastic Cloud, Amazon EC2 Service Characteristics, Monitoring-as-a-Service (MaaS), Protection Against Internal and External Threats, Platform-as-a-Service (PaaS): The Traditional On-Premises Model, The New Cloud Model, Key Characteristics of PaaS, Software-as-a-Service (SaaS): SaaS Implementation Issues, Key Characteristics of SaaS, Benefits of the SaaS Model, Jericho Cloud Cube Model.	12
	Building Cloud Networks	

3	Evolution from Managed service providers (MSP) to Cloud Computing, Single Purpose architectures to multi-purpose architectures, Data center virtualization, Cloud data center, Service Oriented Architectures (SOA), Combining and SOA, Characterizing SOA, Open Source Software in data centers.	12
4	**Security in Cloud Computing** Cloud Security Challenges, Software-as-a-Service Security: Security management, Risk Management, Security Monitoring and Incident Response, Security Architecture Design, Vulnerability Assessment, Data Privacy and Security, Application Security, Virtual Machine Security, disaster Recovery, Disasters in cloud, Disaster management	12
	Tutorial Tutorials will be based on theory.	16

Reading List:

- Cloud Computing, Dr. S.Anandamurugan, T.Priyaa, M.C. ArvindBabu, UNIVERSITY SCIENCE PRESS
- Cloud Computing Bible, Barrie Sosinsky, WILEY Publishing
- Cloud Computing: Principles and Paradigms, RajkumarBuyya, WILEY Publishing

Paper Code: MCA E15

Paper Title: Computational Geometry (4 Credits, L+T+P = 3+1+0)

The objective of this course is to teach the students to learn various algorithms to solve geometrical problems and are exposed to advanced design and analysis techniques. This course provides our students with the knowledge to correctly apply the laws of nature to the creative formulation and solution of engineering problems through the use of analytical, computational and experimental techniques.

The specific learning outcomes are:

1. Apply knowledge of computing, mathematics, science and engineering to solve problems in multidisciplinary research.
2. Analyze a problem, and identify and define the hardware and software requirements appropriate to its solution.

3. Design and conduct experiments and numerical simulations of complex electrical, electronic and computer systems, to analyze, and interpret general scientific and engineering information.

Unit	Content	No. of Lectures
1	**Convex hulls and Triangulations** Convex hulls: construction in 2d and 3d, lower bounds; Triangulations: polygon triangulations, representations, point-set triangulations, planar graphs.	10
2	**Voronoi Diagrams and Delaunay Triangulations** Voronoi diagrams: construction and applications, variants; Delayney triangulations: divide-and-conquer, flip and incremental algorithms, duality of Voronoi diagrams, min-max angle properties;	10
3	**Geometric Searching and Visibility** Geometric searching: point-location, fractional cascading, linear programming with prune and search, finger trees, concatenable queues, segment trees,interval trees; Visibility: algorithms for weak and strong visibility, visibility with reflections, art-gallery problems	10
4	**Arrangements of Lines and Combinatorial Geometry** Arrangements of lines: arrangements of hyperplanes, zone theorems, many-faces complexity and algorithms; Combinatorial geometry: Ham-sandwich cuts.	8
5	**Sweep Techniques and Randomization** Sweep techniques: plane sweep for segment intersections, Fortune's sweep for Voronoi diagrams, topological sweep for line arrangements; Randomization in computational geometry: algorithms, techniques for counting; Robust geometric computing; Applications of computational geometry.	10
	Tutorial Tutorials will be based on theory.	16

Reading List:

- Computational Geometry: An Introduction by Franco P. Preparataand Michael Ian Shamos; SpringerVerlag, 1985.

- Computational Geometry, Algorithms and Applications by Mark de Berg, Marc van Kreveld , Mark Overmars , and Otfried Schwarzkopf ; Springer-Verlag, 1997. from Springer.
- Algorithmische Geometrie (auf deutsch)by Rolf Klein Addison-Wesley, 1996
- Computational Geometry and Computer Graphics in C++ by Michael J. Laszlo (Nova Southeastern University) Prentice-Hall, 1996.

Paper Code: MCA E16

Paper Title: Advanced Computer Architecture (4 Credits, L+T+P = 3+1+0)

The objective of this course is to understand the concept of parallel processing and its applications, analyze the performance of different scalar computers, to develop the pipelining concept for a given set of instructions and to distinguish the performance of pipelining and non-pipelining environments in a processor.

The specific learning outcomes are:

1. Demonstrate concepts of parallelism in hardware/software.
2. Discuss memory organization and mapping techniques.
3. Describe architectural features of advanced processors.
4. Interpret performance of different pipelined processors.
5. Explain data flow in arithmetic algorithms

Unit	Content	No. of Lectures
1	**Fundamentals of Computer Design** Introduction; Classes of computers; Defining computer architecture; Trends in Technology, power in Integrated Circuits and cost; Dependability; Measuring, reporting and summarizing Performance; Quantitative Principles of computer design.	4
2	**Pipelining** Introduction; Pipeline hazards; Implementation of pipeline; what makes	4

	pipelining hard to implement?	
3	**Instruction –Level Parallelism – 1** ILP: Concepts and challenges; BasicCompiler Techniques for exposing ILP; Reducing Branch costs with 74 prediction; Overcoming Data hazards with Dynamic scheduling; Hardware based speculation.	6
4	**Instruction –Level Parallelism – 2** Exploiting ILP using multiple issues and static scheduling; Exploiting ILP using dynamic scheduling, multiple issues and speculation; Advanced Techniques for instruction delivery and Speculation; The Intel Pentium 4 as example.	6
5	**Multiprocessors and Thread –Level Parallelism** Introduction; Symmetric Shared-memory architectures; Performance of symmetric shared–memory multiprocessors; Distributed shared memory and directory-based coherence;Basics of synchronization; Models of Memory Consistency	4
6	**Review of Memory Hierarchy** Introduction; Cache performance; CacheOptimizations, Virtual memory	8
7	**Memory Hierarchy Design** Introduction; Advanced optimizations of Cache Performance; Memory technology and optimizations; Protection: Virtual Memory and virtual machines.	8
8	**Hardware and Software for VLIW and EPIC** Introduction: ExploitingInstruction-Level Parallelism Statically; Detecting and Enhancing Loop-LevelParallelism; Scheduling and Structuring Code for Parallelism; HardwareSupport for Exposing Parallelism: Predicated Instructions; Hardware Support For Compiler Speculation; The Intel IA-64 Architecture and ItaniumProcessor; Conclusions.	8
	Tutorial Tutorials will be based on theory.	16

Reading List:

- John L. Hennessey and David A. Patterson: Computer Architecture, A Quantitative Approach, 4th Edition, Elsevier, 2007.
- Kai Hwang: Advanced Computer Architecture Parallelism, Scalability, Programmability**,** 2nd Edition**,** Tata Mc Graw Hill, 2010

- David E. Culler, Jaswinder Pal Singh, Anoop Gupta: Parallel Computer Architecture, A Hardware / Software Approach, Morgan Kaufman, 1999.

Paper Code: MCA E17

Paper Title: Wireless Network (4 Credits, L+T+P = 3+1+0)

The objective of this course is to expose the students to understand mobile radio communication principles and to study the recent trends adopted in cellular systems and wireless standards.

The specific learning outcomes are:

1. Discuss the cellular system design and technical challenges.
2. Analyze Multiuser Systems, CDMA, WCDMA network planning and OFDM Concepts.
3. Summarize the principles and applications of wireless systems and standards.
4. Develop knowledge of the interplay of concepts and multiple sub-disciplines in mobile and wireless systems.

Unit	Content	No. of Lectures
1	**Multiple Radio Access** Medium Access Alternatives: Fixed-Assignment for Voice Oriented Networks Random Access for Data Oriented Networks, Handoff and Roaming Support, Security and Privacy.	10
2	**Wireless WANs** First Generation Analog, Second Generation TDMA – GSM, Short Messaging Service in GSM, Second Generation CDMA – IS-95, GPRS - Third Generation Systems (WCDMA/CDMA 2000)	10
3	**Wireless LANs** Introduction to wireless LANs - IEEE 802.11 WLAN – Architecture and Services,Physical Layer- MAC sublayer- MAC Management Sublayer, Other IEEE 802.11 standards, HIPERLAN, WiMax standard.	10
4	**Ad Hoc and Sensor Networks** Characteristics of MANETs, Table-driven and Source-initiated On Demand routing protocols, Hybrid protocols, Wireless Sensor networks-	10

	Classification, MAC and Routing protocols.	
5	**Wireless MANs and PANs** Wireless MANs – Physical and MAC layer details, Wireless PANs – Architecture of Bluetooth Systems, Physical and MAC layer details, Standards.	8
	Tutorial Tutorials will be based on theory.	16

Reading List:

- William Stallings, "Wireless Communications and networks" Pearson / Prentice Hall of India, 2nd Ed., 2007.
- Dharma Prakash Agrawal & Qing-An Zeng, "Introduction to Wireless and Mobile Systems", Thomson India Edition, 2nd Ed., 2007.
- Vijay. K. Garg, "Wireless Communication and Networking", Morgan Kaufmann Publishers, 2007.
- KavethPahlavan, Prashant Krishnamurthy, "Principles of Wireless Networks",Pearson Education Asia, 2002.

Paper Code: MCA E18

Paper Title: Speech Processing (4 Credits, L+T+P = 3+1+0)

This subject aims to make the students familiar with the state-of-the-art theories and technologies behind various speech-related products and services, such as mobile phones, voice search, Internet phones, dialog systems, voice biometrics, and voice cloning. The course will cover theoretical foundations, algorithms, and practical issues of speech processing and recognition systems. The course will put emphasis on how recent advances in deep learning and deep neural networks revolutionaries these systems.

The specific learning outcomes are:

1. Master the fundamental principles behind voice-enable products and services.
2. Know what the current state-of-the-art speech technologies can offer
3. Apply speech processing technologies to voice-enabled products and services
4. Take the limitations of current speech technologies into consideration when deploying voice-enabled services.

Unit	Content	No. of Lectures
1	**Basic Concepts** Speech Fundamentals: Articulatory Phonetics – Production and Classification of Speech Sounds; Acoustic Phonetics – acoustics of speech production; Review of Digital Signal Processing concepts; Short-Time Fourier Transform, Filter-Bank and LPC Methods.	10
2	**Speech Analysis** Features, Feature Extraction and Pattern Comparison Techniques: Speech distortion measures – mathematical and perceptual – Log Spectral Distance, Cepstral Distances, Weighted Cepstral Distances and Filtering, Likelihood Distortions, Spectral Distortion using a Warped Frequency Scale, LPC, PLP and MFCC Coefficients, Time Alignment and Normalization – Dynamic Time Warping, Multiple Time – Alignment Paths.	10
3	**Speech Modeling** Hidden Markov Models: Markov Processes, HMMs – Evaluation, Optimal State Sequence – Viterbi Search, Baum-Welch Parameter Re-estimation, Implementation issues.	10
4	**Speech Recognition** Large Vocabulary Continuous Speech Recognition: Architecture of a large vocabulary continuous speech recognition system – acoustics and language models – n-grams, context dependent sub-word units; Applications and present status.	8
5	**Speech Synthesis** Text-to-Speech Synthesis: Concatenative and waveform synthesis methods, sub-word units for TTS, intelligibility and naturalness – role of prosody, Applications and present status.	10
	Tutorial Tutorials will be based on theory.	16

Reading List:

- Lawrence Rabiner and Biing-Hwang Juang, “Fundamentals of Speech Recognition”, Pearson Education, 2003.

- .Daniel Jurafsky and James H Martin, “Speech and Language Processing – An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition”, Pearson Education.
- Steven W. Smith, “The Scientist and Engineer’s Guide to Digital Signal Processing”, California Technical Publishing.
- Thomas F Quatieri, “Discrete-Time Speech Signal Processing – Principles and Practice”, Pearson Education.

Paper Code: MCA E19

Paper Title: Multimedia System (4 Credits, L+T+P = 3+1+0)

This course aims to introduce the fundamental elements of multimedia. The emphasis will be on learning the representations, perceptions and applications of multimedia. Software skills and hands-on work on digital media will also be emphasized.

The specific learning outcomes are:

1. Understand the technologies behind multimedia applications and master the skills for developing multimedia projects.
2. Summarize the key concepts in current multimedia technology.
3. Develop competencies in designing and creating interactive multimedia.
4. Work with all aspects of text, audio, images and video.
5. Learn the phases involved in multimedia planning, design and production.

Unit	Content	No. of Lectures
1	**Introduction** Definition - CD-ROM and multimedia. Multimedia applications: business, schools, homes, public places and virtual reality. Introduction to making multimedia: hardware, software, creativity and organization.	8
	Multimedia Tools	

2	Macintosh and windows production platforms - 3-d modeling and animation - image-editing tools - sound editing tools - animation - video - and digital movie tools - linking multimedia objects - office suites - word processors - spreadsheets - databases - presentation tools. Authoring tools - Card and Page-based authoring tools - Icon Based authoring tools - time based authoring tools - object oriented authoring tools - cross platform-authoring tools.	10
3	**Multimedia Building Blocks** Text:- About fonts and faces - text in multimedia - computers and text - Font editing and design tools: Hypermedia and Hypertext. Sound: -Multimedia system sounds - MIDI versus digital audio - digital audio - making MIDI audio :- audio file format - working with sounds in windows - working with sounds on the Macintosh - NIFF - Adding sounds to multimedia - Towards professional sounds - production tips. Images: -Making still images - Colors - Image file format. Animation: Principles of animation: Making animation that works. Video: How video works - Broadcast video standards - Integrating computers and television - Shooting and Editing - Video tips - Recoding formats - Digital video.	10
4	**Multimedia and the Internet** Internet fundamentals: Internetworking - Connections - Internet services - The World Wide Web - Tools for the World Wide Web: Web serves - Web browsers - Web page makers and Site builders - Plug-ins and Delivery vehicles - Beyond HTML	10
5	**Designing For The World Wide Web** Working on web - Text for web - Images for web - Sound for web - Animation for web.	10
	Tutorial Tutorials will be based on theory.	16

Reading List:

- Multimedia System Design- K. Andleigh and K. Thakkrar
- Multimedia: Computing, Communication & Application - Ralf stein Metz and KlaraNahrstedt
- Advanced multimedia programming - Steve Rimmer
- Multimedia Literacy - Fred T.HofstetterMGHill

Paper Code: MCA E20

Paper Title: Pattern Recognition (4 Credits, L+T+P = 3+1+0)

This course aims to introduce the pattern recognition techniques used to design automated systems that improve their own performance through experience. This course covers the methodologies, technologies, and algorithms of statistical pattern recognition from a variety of perspectives.

The specific learning outcomes are:

1. Understand basic concepts in pattern recognition
2. Gain knowledge about state-of-the-art algorithms used in pattern recognition research..
3. Understand pattern recognition theories, such as Bayes classifier.
4. Apply pattern recognition techniques in practical problems.

Unit	Content	No. of Lectures
1	**Introduction** Applications of pattern recognition, statistical decision theory, image processing and analysis.	4
2	**Probability** Introduction, probability of events, random variables, Joint distributions and densities, moments of random variables, estimation of parameters from samples, minimum risk estimators	6
3	**Statistical Decision Making** Introduction, Baye's Theorem, multiple features, conditionally independent features, decision boundaries, unequal costs of error, estimation of error rates, the leaving-one—out technique. Characteristic curves, estimating the composition of populations.	10
4	**Nonparametric Decision Making** Introduction, histograms, Kernel and window estimators, nearest neighbor classification techniques, adaptive decision boundaries, adaptive discriminant Functions, minimum squared error discriminant functions, choosing a decision making technique.	10
5	**Clustering** Introduction, hierarchical clustering, partitional clustering.	4
	Artificial Neural Networks	

6	**I**ntroduction, nets without hidden layers. nets with hidden layers, the back Propagation algorithms, Hopfield nets, an application.	6
7	**Processing of Waveforms and Images** Introduction, gray level sealing transformations, equalization, geometric image and interpolation, Smoothing, transformations, edge detection, Laplacian and sharpening operators, line detection and template matching, logarithmic gray level sealing, the statistical significance of image features.	8
	Tutorial Tutorials will be based on theory.	16

Reading List:

- EartGose, Richard Johnsonburg and Steve Joust, "Pattern Recognition and Image Analysis", Prentice-Hall of India2003.
- Duda and Hart, "Pattern recognition (Pattern recognition a scene analysis)".
- Robert J Schalkoff, "Pattern recognition: Statistical, Structural and neural approaches", John Wiley

Paper Code: MCA E21

Paper Title: Artificial Intelligence (4 Credits, L+T+P = 3+1+0)

The primary objective of this course is to introduce the basic principles, techniques, and applications of artificial intelligence. This course will help the students to gain a historical perspective of AI and its foundations, become familiar with basic principles of AI toward problem solving, inference, perception, knowledge representation, and learning, investigate applications of AI techniques in intelligent agents, expert systems, artificial neural networks and other machine learning models, experiment with a machine learning model for simulation and analysis.

The specific learning outcomes are:

1. Demonstrate fundamental understanding of the history of artificial intelligence (AI) and its foundations.
2. Apply basic principles of AI in solutions that require problem solving, inference, perception,knowledge representation, and learning.

3. Demonstrate awareness and a fundamental understanding of various applications of AItechniques in intelligent agents, expert systems, artificial neural networks and other machine learning models.
4. Demonstrate proficiency in applying scientific methods to models of machine learning.

Unit	Content	No. of Lectures
1	**Introduction** Definition of artificial intelligence, Numerical computation, information storage, repetitive operations, other definitions of artificial intelligence, numeric versus symbolic, algorithm versus non algorithms, area if artificial intelligence, expert system, natural language processing, speech recognition, automatic programming, organization of artificial intelligence system, the underlying assumptions, artificial intelligence techniques.	8
2	**Problem Solving** Is the good solution absolute or relative, production systems, production system characteristics, problem solving: defining the problem as a state space search, Water Jug Problem ,Basic problem solving methods : Reason forward from the initial states , Reason backward from the goal states, Problem trees versus Problem Graphs, Knowledge representation: Matching and Indexing.	10
3	**Heuristic Methods** Heuristic search, Heuristic functions, Or graph, ANDOR graph, Weak methods: Generate and Test, Hill Climbing, Breadth first search, Best first search, OR graph, Problem reduction, Constraints satisfaction, Means End Analysis.	10
4	**Game Playing** The Minimax Procedure , Adding Alpha Beta Cutoffs, Knowledge Representation using predicate logic, Representing simple facts in logic, Augmenting the representation with computable functions and predicates, Resolution, Conversion to clause form, The basis of resolution, Resolution in propositional logic , The Unification algorithm, Resolution in predicate logic , Resolution algorithm for predicate logic, Introduction to Non-monotonic Reasoning, Statistical and probabilistic reasoning.	10
	Natural Language Understanding Natural language Understanding, Introduction to Understanding, What	

5	makes understanding hard, Understanding single sentences , Keyword matching , Syntactic analysis , semantic analysis , semantic grammars ,Case grammars Learning: Introduction to learning, Random learning and Neural nets, Learning by parameter adjustment, Learning in General Problem Solver (GPS), Concept Learning.	10
	Tutorial Tutorials will be based on theory.	16

Reading List:

- Artificial Intelligence Elaine Rich McGraw Hill book Co. 1982.
- Artificial Intelligence PH Winston, Addison Wesley,1983.
- Artificial Intelligence Concepts, Techniques and Applications. Yoshiaki Shirai n Junichi Tsujii, John Willey sons.

Paper Code: MCA E22

Paper Title: Machine Learning (4 Credits, L+T+P = 3+1+0)

The objective of this course is to understand the basic theory underlying machine learning, to formulate machine learning problems corresponding to different applications. The students will understand a range of machine learning algorithms along with their strengths and weaknesses. To apply the algorithms to a real-world problem, optimize the models learned and report on the expected accuracy that can be achieved by applying the models.

The specific learning outcomes are:

1. Have a good understanding of the fundamental issues and challenges of machine learning: data, model selection, model complexity, etc.
2. Have an understanding of the strengths and weaknesses of many popular machine learning approaches.
3. Appreciate the underlying mathematical relationships within and across Machine Learning algorithms and the paradigms of supervised and unsupervised learning.
4. Be able to design and implement various machine learning algorithms in a range of real-world applications.

Unit	Content	No. of Lectures
	Introduction Definition of learning systems. Goals, applications, aspects, Concept	

1	representation, Function approximation. Inductive Classification: The concept learning task. Concept learning as search through a hypothesis space. General-to-specific ordering of hypotheses. Finding maximally specific hypotheses. Version spaces and the candidate elimination algorithm. Learning conjunctive concepts. Inductive bias.	10
2	**Decision Tree Learning** Entropy and information gain. Occam's razor. Overfitting, noisy data, and pruning. Ensemble Learning: Using committees of multiple hypotheses. Bagging, boosting, and DECORATE. Active learning with ensembles. Experimental Evaluation of Learning Algorithms: Measuring the accuracy of learned hypotheses. Comparing learning algorithms: cross-validation, learning curves, and statistical hypothesis testing.	6
3	**Computational Learning Theory** Learning in the limit; probably approximately correct (PAC) learning. Sample complexity: quantifying the number of examples needed to PAC learn. kDNF, and kCNF. Sample complexity for infinite hypothesis spaces, Vapnik-Chervonenkis dimension. Rule Learning: Propositional and First-Order: Translating decision trees into rules. Heuristic rule induction using separate and conquer and information gain.	4
4	**Artificial Neural Networks** Neurons, Linear threshold units. Perceptrons: representational limitation and gradient descent training. Multilayer networks and backpropagation. Support Vector Machines: Maximum margin linear separators. Quadratic programming solution to finding maximum margin separators. Kernels for learning non-linear functions. Bayesian Learning: Bayes rule. Naive Bayes learning algorithm. Parameter smoothing. Generative vs. discriminative training. Logistic regression.	5
5	**Instance-Based Learning** K-Nearest-neighbor algorithm. Case-based learning. Text Classification: Bag of words representation. Vector space model and cosine similarity. Relevance feedback and Rocchio algorithm. Clustering and Unsupervised Learning: Clustering. Hierarchical Agglomerative Clustering. k-means partitional clustering. Expectation maximization (EM) for soft clustering.	5
6	**Support Vector Machines** Support Vector Machines -- Introduction, obtaining the optimal hyperplane, SVM formulation with slack variables; nonlinear SVM	8

	classifiers,Kernel Functions for nonlinear SVMs; Mercer and positive definite Kernels, Support Vector Regression and ε-insensitive Loss function, examples of SVM learning.	
7	**Feature Selection, Model assessment and cross-validation** Feature Selection and Dimensionality Reduction; Principal Component Analysis, Assessing Learnt classifiers; Cross Validation.	5
8	**Boosting and Classifier Ensembles** Bootstrap, Bagging and Boosting; Classifier Ensembles;AdaBoost.	5
	Tutorial Tutorials will be based on theory.	16

Reading List:

- Tom Mitchell, Machine Learning, McGraw-Hill.
- EthemAlpaydin, Introduction to Machine Learning, MIT Press, 2004.
- Christopher M. Bishop, Pattern Recognition and Machine Learning, Springer, 2006.
- Richard O. Duda, Peter E. Hart & David G. Stork, Pattern Classification, Wiley

Paper Code: MCA E23

Paper Title: Big Data (4 Credits, L+T+P = 3+1+0)

This course will teach you to understand the Big Data Platform and its use cases, provide an overview of Apache Hadoop, provide HDFS Concepts and Interfacing with HDFS, understand Map Reduce Jobs, provide hands on Hadoop EcoSystem, apply analytics on Structured, Unstructured Data.

The specific learning outcomes are:

1. Identify Big Data and its Business Implications.
2. List the components of Hadoop and Hadoop Ecosystem
3. Access and Process Data on Distributed File System
4. Manage Job Execution in Hadoop Environment
5. Develop Big Data Solutions using Hadoop EcoSystem

Unit	Content	No. of Lectures

1	**Introduction to Big Data** Introduction, distributed file system,Big Data and its importance, Four Vs, Drivers for Big data, Big data analytics, big data applications. Algorithms using map Reduce, Matrix vector multiplication by Map Reduce	8
2	**Introduction to Hadoop and Hadoop Architecture** Big Data Apache Hadoop and Hadoop EcoSystem, Moving Data in and out of Hadoop, Understanding inputs and outputs of MapReduce, Data Serialization.	8
3	**HDFS, HIVE and HIVEQL, HBAS** HDFS Overview, Installation and Shell, Java API; Hive Architecture and Installation, Comparison with Traditional Database, HiveQL Querying Data, Sorting and Aggregating, Map Reduce Scripts, Joins & Sub queries, Hbase concepts, Advanced Usage, Schema Design, Advance Indexing, PIG, Zookeeper, how it helps in monitoring a cluster , Hbase uses Zookeeper and how to Build Applications with Zookeeper.	9
4	**SPARK** Introduction to Data Analysis with Spark, Downloading Spark and getting started, Programming with RDDs, Machine Learning with Mllib.	9
5	**HADOOP ECOSYSTEM and YARN** Hadoop ecosystem components-Schedulers – Fair and capacity, Hadoop 2.0 New Features-NameNode High Availability, HDFS Federation, MRv2, YARN, Running MRv1 in YARN	7
6	**Database for the Modern Web** Introduction to MongoDB key features, Core Server tools, MongoDB through the JavaScript's Shell, Creating and Querying through Indexes, Document Oriented, principles of schema design, Constructing queries on Databases, collections and Documents, MongoDB Query Language.	7
	Tutorial Tutorials will be based on theory.	16

Reading List:

- BIG Data and Analytics , Sima Acharya, Subhashini Chhellappan, Willey
- MongoDB in Action, Kyle Banker, Piter Bakkum , Shaun Verch, Dream tech Press
- Tom White, “HADOOP: The definitive Guide”, O Reilly 2012.

Paper Code: MCA 1001

Paper Title: Major Project (18 Credits, L+T+P = 0+0+18)

In the Major Project, students are expected to have a thorough understanding of the theoretical principles learned in earlier five semesters through prolonged practical experience in a real life project. The major project is oriented towards developing requisite skills, knowledge of latest technologies and an entrepreneurial attitude in a student which are needed to make an effective start as a computer/IT professional. A dissertation report depicting the work, in specified format, has to be submitted in the department. The progress of the project will be continuously monitored and evaluated. The final evaluation of the project will be done at the end of the semester through presentation and viva.

Paper Code: MCA 1002

Paper Title: Seminar (2 Credits, L+T+P = 0+0+2)

While doing the Major Project, students are expected to present a seminar briefing on his project proposal. The evaluation of the seminar will be done at the mid of the semester through presentation and viva.